

ALAGAPPA UNIVERSITY

(A State University Established by the Government of Tamilnadu-
Reaccredited with 'A' Grade by NAAC)
KARAIKUDI – 630 003
Tamil Nadu, INDIA

DIRECTORATE OF DISTANCE EDUCATION

(Recognized by Distance Education Council (DEC), New Delhi)



TM 3.3

MBA (PRODUCTION AND OPERATIONS MANAGEMENT)

PAPER - 4.2

MANAGEMENT OF INNOVATION AND R&D

MANAGEMENT OF INNOVATION AND R&D

MBA (PRODUCTION AND OPERATIONS MANAGEMENT)

Paper – 4.2

Self Learning Material



DIRECTORATE OF DISTANCE EDUCATION
ALAGAPPA UNIVERSITY
KARAIKUDI-630003
TAMILNADU

Developed by:

Mr. Ramgopal Bhargav is currently working as a Project Manager. He has been associated with a leading Management Institute as a visiting faculty. He has developed content for a number of management and accounting books for some leading universities of India and overseas. Before starting his professional career he completed his MBA in finance from ICFAI Business School (IBS) Chandigarh. He also worked on a number of research projects for SME financing in India and growth in Indian insurance sector.

Reviewed by:

Dr. V. Balachandran,
Professor,
Department of Corporate Secretaryship,
School of Management
Alagappa University, Karaikudi-630003

Published by : Laxmi Publications Pvt Ltd., 113, Golden House, Daryaganj, New Delhi-110 002.
Tel: 43532500, E-mail: info@laxmipublications.com

The Work order number (AU/DDE/D2/Printing/01/2014-15 Date: 30.10.2014 Copies 1000)

C—9548/014/11

DAL-2284-068- MANAGEMENT OF INNOV R&D
Typeset at: M2W Media, Delhi

Printed at: Ajit Printing Press, Delhi

SYLLABUS

MBA (Production and Operations Management)

4.2: MANAGEMENT OF INNOVATION AND R&D

Unit 1: Concept of Innovations and R&D: Meaning of Innovation- Requisites for Innovation: Creativity, Scientific Temper, Invention, Proto-type Development, Testing, Refinement, Perfection and Diffusion – Jay Doblin's Ten Types of Innovation – Jennifer Goddard's six focus areas for innovation - Innovation models of John Besant and Joe Tidd- R&D the back-bone of Technological Innovation- R & D and Economic Development Nexus- Technology innovators- Business Model innovators- Process innovators.

Unit 2: Innovation and Human Intellect: Creativity and Problem Solving: The Creative Process- Intellect and Creativity- Creative Individuals and Out-of-box thinking- Techniques of Transforming Creativity into Invention and Invention into Innovation- Sources of Innovation- Michael Lee Scritchfield's 4P's of Creativity/Innovation: Product, Process, Person and Press (Place) - 4 Zones of Innovation: Product Leadership, Customer Intimacy, Operational Excellence and Category Renewal- Innovation failures.

Unit 3 : Theories of Creativity, Innovation, Technology and R&D: Behavioral theory of R&D investment and Innovation- Open Innovation theory- Dominant design theory- Technology S-curve theory- Brainstorming theory- Ed DeBono's Six Thinking Hats- Combination method- Brinnovation (breakthrough innovation)- Benchmarking- Complexity Theory- TRIZ/TIPS theory- Chris Grannell's Innovation Strategies- Role of MNCs in R&D – MNCs in US, EU and Japan in R&D Triad.

Unit 4: Innovating Firms: Understanding the Innovative Features of the selected top innovators of the world, namely: The Facebook, Amazon, Apple, Google, Novartis, Walmart, HP, Nike, Intel, IBM, GE, Disney, Cricket, IPL 20-20, Samsung, Microsoft and Twitter - Organizational climate for Creativity and Innovation- Autonomy and Entrepreneurship, Close to the Customer, Competitive Spirit, Failure tolerance, organizational support and Managing Ambiguity and Paradox.

Unit 5: Patenting of Innovation: Patenting Inventions and Innovations- Role of Patents, Copy Rights, Trade Marks and Licenses in Innovation and R&D management– Intellectual property rights - Decision support systems in R& D– Process Vs Product Innovation- Reverse Engineering- Law regarding Protection of Innovations from Imitations.

Unit 6: Corporate and Government Commitment to Innovation and R&D: R & D as a Corporate Function – In-house R & D Resources and Commitment – Partnership in Innovation– Financiers of R & D Projects – Role of Consultants in R & D- Creating a productive team culture – Government support for R&D infrastructure and researchers- Role of DST, DBT and CSIR- Global Innovation Index-Innovation Efficiency Index: Input Index and Output Index.

REFERENCES

1. Tom Peters and Robert Waterman, *In Search of Excellence*, London: Harper & Row 1982.
2. Alvin Toffler. *Future Shock. New York*, Bantom1971.
3. V. Govindarajan & C.Trimble, *The Other Side of Innovation*, HBSP, 2010.
4. V. Govindarajan & C.Trimble, *Ten Rules for Strategic Innovators*, HBSP, 2005.
5. Silverstein, Samuel and Decarlo, *The Innovator's Toolkit,* Wiley, 2008.
6. P Skarzynski and R Gibson, *Innovation to the Core*,HBSP, 2008
7. Scott Berkun, *The Myths of Innovation*, O'Reilly Media, 2010.
8. Braden Kelley & Rowan Gibson, *Stoking Your Innovation Bonfire*, Wiley, 2010.
9. James M. Utterback, *Mastering the Dynamics of Innovation*, 1994.
10. Peter F. Drucker, *Innovation and Entrepreneurship,* Harper, 2006.
11. WIPO, World Intellectual Property Organization's Publications.

CONTENTS

UNIT 1 CONCEPT OF INNOVATIONS AND R&D

Structure

1.0 INTRODUCTION

Innovation means the development of a new idea and implementing the established ways of doing things for common use. A new technical idea is incorporated into a commercial product or process and is put in the market. Innovations are broadly divided into technological innovations, product innovations, process innovations and management innovations.

In the evolving and highly technical environment, innovation is the only key which can sustain long-run growth of the country. More and more firms are realizing the significance of innovation to gain competitive advantage. Accordingly, they are indulging themselves in a number of innovative activities, ranging from manufacturing processes, product improvement, and brand building initiatives to customer satisfaction. In recent days, business environment has become very dynamic with more challenging customers and intense market competition. To meet this, firms are creating new products, solutions and services that provide a radically better experience for the consumers.

Innovation is not only about technology, but also about understanding and exploring the needs of untapped that require to be addressed in an efficient manner. Innovation takes place at every stage of a product or solution development and release cycle. Thus, managing innovation is fast becoming priority in a global business environment.

1.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Define innovation
- Discuss Jay Doblin's ten types of innovation
- Explain types of innovators.

1.2 MEANING OF INNOVATION

The term innovation may be defined as a process by which varying degrees of measurable value enhancement is planned and achieved, in any commercial activity. The innovation may be achieved by:

- introducing new or improved goods or services and/or
- implementing new or improved operational processes and/ or
- implementing new or improved organizational/ managerial processes

An idea or project is not an innovation unless it is applied in practice and put onto the market. Innovation occurs at the intersection of invention and insight. It is about the application of invention - the fusion of new developments and new approaches to solve problems.

Definitions of innovation found in the literature vary according to the level of analysis, which is used. The more macro the approach (e.g., social, cultural) the more varied the definitions seem to be (West and Farr, 1990). Some definitions are general and broad, while others focus on specific innovations like the implementation of an idea for a new product or service. In an organizational environment, examples of innovation are the implementation of ideas for restructuring, or saving of costs, improved communication, new technology for production processes, new organizational structures and new personnel plans or programmes (Kanter, 1983 cited in West and Farr, 1990; Robbins, 1996).

West and Farr (1990) define innovation as follows: "the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society". It appears that the context in which a new idea, product, service or activity is implemented determines whether it can be regarded as an innovation within that specific context.

Innovations are broadly divided into the following types:

- **Technological innovations:** Technological innovations are associated with the use of technological knowledge, research and development activities. Any innovation due to an industrial application of scientific knowledge is a technological innovation.
- **Product innovations:** Product innovations involve introduction of new goods and services which are significantly improved in terms of design excellence, core characteristics, technical specifications etc.
- **Process innovations:** Process innovations comprises introduction of a new or significantly improved production process involving new ways of producing goods and services that maximizes speed, service, quality, simplicity and waste reduction.
- **Management innovations:** Management innovations essentially means implementation of new management practices, innovative ways of doing things and dramatically transforming and improving the effectiveness of management functions and significant departure from the current norms.

Successful innovations occur when technological, product, or process innovations in the value chain are implemented through effective management innovations. Innovation as a driver for growth, profitability and success of an organization includes people, leadership, creativity, process and organizational culture. Innovation in an organization should not be approached in a piecemeal manner but in a systematic enterprise wide capability including the lowest levels.

1.3 REQUISITES OF INNOVATION

The following are the key requisites of innovation:

1.3.1 Creativity

Creativity is the ability to produce new and original ideas and things. Creativity is synonymous with inventiveness. R&D and innovation are creative processes. Creativity brings new ideas or concepts into being. The inventiveness of an innovator is linked with his creativity. Innovation makes the idea practical and usable. The innovative activity in any business enterprise depends upon the creative contribution of its members. It also depends upon how the organization taps the creativity of its talented members and what kind of environment prevails. Creativity is believed to thrive in an organization which values the creative contributions of its members and is receptive to or appreciative of new or unconventional ideas or ways of doing things. The structure of the organization, internal systems, methods of performance evaluation, incentives and rewards, or performance recognition policies play a crucial role in building the appropriate organizational environment conducive for research

NOTES

and innovation. All these factors together constitute the climate the organization.

Teresa Amabile, PhD in Psychology and Head of the Entrepreneurial Management Unit at the Harvard Business School, has provided the field with one of the most simple and yet comprehensive frameworks for the topic. As depicted in the diagram, creativity arises through the confluence of the following three components:

- **Knowledge:** All the relevant understanding an individual brings to bear on a creative effort.
- **Creative Thinking:** Relates to how people approach problems and depends on personality and thinking/working style.
- **Motivation:** Motivation is generally accepted as key to creative production, and the most important motivators are intrinsic passion and interest in the work itself.

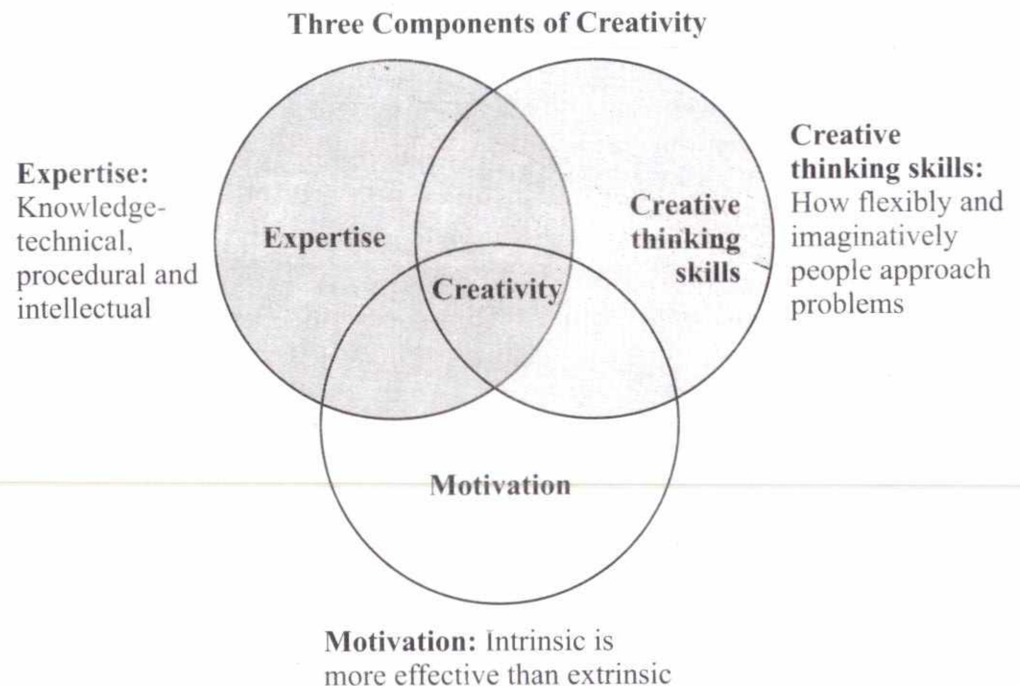


Fig. 1.1: Components of creative thinking

Most literature on creativity and innovation in the workplace targets an audience of managers and business leaders and focuses on methods to foster organizational climates conducive to innovation. A recurring message is that companies have historically approached the creative climate in different ways and "there is no recipe for systemic creativity." One essential element, however, is that top management holds the power to set the tone and thus plays a key role in whether a company will be innovative or not. Management "must ask for technical innovation, demand it, encourage it, stimulate it, fund it, and reward it." Management must truly want and be committed to creativity and be willing to sacrifice short term results for innovation.

In designing a workplace environment conducive to innovation, management must consider the same elements that are key to creativity in individuals: knowledge, creative motivation. Amabile explains that in the workplace, it is easier to influence intrinsic motivation than to influence knowledge or creative thinking styles which are longer term pursuits. She suggests that management can bolster intrinsic motivation through focus on the following six areas:

- **Challenge:** Match people to jobs where challenge/stretch is optimized: "not so little that they feel bored but not so much they feel overwhelmed and threatened by a loss of control. One of the most common ways managers kill creativity is by not trying to obtain the information necessary to make good connections between people and jobs."
- **Freedom:** Give people autonomy concerning the process, not necessarily the end. In fact, clearly specified strategic goals often enhance people's creativity, but freedom in process enhances sense of ownership. At the same time, programs that do employees to choose their goals have also been known to enhance creativity. At 3M, employees have 15% of their time to pursue their own projects. These projects routinely spark successful outputs.
- **Resources:** Resources in both time and money are important. Under some circumstances time pressure can enhance creativity by increasing urgency and sense of challenge, but fake or impossibly tight deadlines create distrust and cause burnout. In fact, in a study of 177 employees in 22 projects from seven companies, Amabile, discovered that people are less creative under time pressure, despite the fact that they think they are more so. Allowing time for evaluation and playing is key.
- **Work-Group Features:** When teams include people of varied perspectives, ideas combine and combust in interesting ways. Teams must share excitement, be team players, and recognize the value that each member brings to the table. Creating such teams requires managers to have excellent knowledge of their people.
- **Supervisory encouragement:** Freely and generously recognize creative work even before the commercial impact of that work is known. In general, people react to new ideas with a criticism bias. They think about why not to use it instead of how to explore it further. This creates a climate of negativity and fear and should be consciously overcome. As highlighted by multiple researchers and theorists, an organization's culture and attitude toward failure are key to promoting innovation. Organizations that tolerate failure and encourage risk-taking are more likely to see successful innovation.
- **Organizational support:** Intrinsic motivation increases when people are aware that those around them are excited and where there's information sharing and collaboration. Bad politics is to be avoided and gets in the way.

Check Your Progress

Fill in the Blanks:

1. Innovation is not only about .... but also about understanding and exploring the needs of untapped that require to be addressed in an efficient manner.
2. R&D and innovation are .... processes.
3. .... is generally accepted as key to creative production, and the most important motivators are intrinsic passion and interest in the work itself.

1.3.2 Scientific Temper

Scientific temper is an attitude of applying logic and avoidance of preconceived ideas. In simple terms we can say that scientific temper includes the creative thinking. Both Amabile and Gardner assert that thinking is a key aspect of the creative process; they address this topic at a high level. Amabile suggests that key aspects of creative thinking are:

- Comfort in disagreeing with others and trying solutions that depart from the status quo.
- Combining knowledge from previously disparate fields.
- Ability to persevere through difficult problems and dry spells.
- Ability to step away from an effort and return later with a fresh perspective ("incubation").

Other theorists have addressed the topic of cognitive function from multiple angles. Sternberg's article, "Creativity and Intelligence" in the Handbook of Creativity, provides an overview of the multitude of theories that have been proposed concerning the relationship between creativity and intelligence. While there is no consensus on the subject, multiple theories provide insight. Ultimately, Sternberg promotes a "triarchic theory", asserting that there are three main aspects of intelligence that are key for creativity – synthetic, analytical and practical:

1. **Synthetic (creative):** the ability to generate ideas that are novel, high quality and task appropriate. One aspect of this is the ability to redefine problems effectively and to think insightfully. Sternberg also notes that the basis for insightful thinking involves knowledge acquisition in three forms:
   - **Selective encoding:** distinguishing relevant from irrelevant information.
   - **Selective combination:** combining bits of relevant information in novel ways.
   - **Selective comparison:** relating new information to old information in novel ways.
2. **Analytical:** Critical/analytical thinking is involved in creativity as the ability to judge the value of one's own ideas, to evaluate their strengths and weaknesses and suggest ways to improve them.
3. **Practical:** Ability to apply intellectual skills in everyday contexts and to "sell" creative ideas.

In his article, "Creative Thinking in the Classroom" Sternberg stresses the importance of these three types of thinking to overall to intellectual functioning and successful intelligence. The analytic and practical are separate from and support the synthetic. Studies indicate that when students were taught in a way that emphasized all three abilities, they significantly outperformed students taught in a way that emphasized only analytical abilities. The holistic approach also increased performance on strictly analytical, memory-related questions.

Sternberg also explains, "Because the analytical, synthetic and practical aspects of abilities are only weakly related, students who are adept in one of these areas might not benefit particularly from instruction aimed at another area, and in particular, creative students might not benefit particularly well from instruction as it is given in the schools, which typically emphasizes memory and analytical abilities." In an experiment, they found that "high school students who were taught in a way that better matched their own pattern of abilities tended to achieve at higher levels than students who were taught in a way that more poorly matched their pattern of abilities."

List of Qualities that Describe Innovators

- Challenges status quo: Dissatisfied with current reality, questions authority and routine and confronts assumptions.
- Curious: Actively explores the environment, investigates new possibilities, and honours the sense of awe and wonder.
- Self-motivated: Responds to deep inner needs, proactively initiates new projects, intrinsically rewarded for efforts.
- Visionary: Highly imaginative, maintains a future orientation, thinks in mental pictures.
- Entertains the fantastic: Conjures outrageous scenarios, sees possibilities within the seemingly impossible, honours dreams and daydreams.
- Takes risks: Goes beyond the comfort zone, experimental and nonconforming, courageously willing to "fail".
- Peripatetic : Changes work environments as needed; wanders, walks or travels to inspire fresh thinking; given to movement and interaction.
- Playful/humorous: Appreciates incongruities and surprise, able to appear foolish and child-like, laughs easily and often.
- Self-accepting: Withholds compulsive criticism of their own ideas, understands "perfection is the enemy of the good" unattached to "looking good" in the eyes of others.
- Flexible/adaptive: Open to serendipity and change, able to adjust "game plan" as needed, entertains multiple ideas and solutions.
- Makes new connections: Sees relationships between seemingly disconnected elements, synthesizes odd combinations, distills unusual ideas down to their underlying principles.
- Reflective: Incubates on problems and challenges; seeks out states of immersion; ponders, muses and contemplates.
- Recognizes (and re-cognizes) patterns: Perceptive and discriminating, notices organizing principles and trends, sees (and challenges) the "Big Picture."
- Tolerates ambiguity: Comfortable with chaos, able to entertain paradox, doesn't settle for the first "right idea".
- Committed to learning: Continually seeks knowledge, synthesizes new input quickly, balances information gathering and action.

- Balances intuition and analysis: Alternates between divergent and convergent thinking; entertains hunches before analyzing them; trusts their gut, uses their head.
- Situationally collaborative: Balances rugged individualism with political savvy, open to coaching and support, rallies organizational support as needed.
- Formally articulate: Communicates ideas effectively, translates abstract concepts into meaningful language, creates prototypes with ease.
- Resilient: Bounces back from disappointment, learns quickly from feedback, willing to "try, try again".
- Persevering: Hardworking and persistent, champions new ideas with tenacity, committed to follow-through and bottom-line results.

Source : *"Free the Genie" series, a set of 12 creative thinking booklets by Mitchell Ditkof, President, Idea Champions.*

1.3.3 Invention

Inventors often possess creative minds. They perform similar feats of reality bending. Invention differs from creativity in important ways.

First, invention is constrained by reality. While an artist can imagine paradoxical scenes like an Escher staircase, an inventor works within a framework of possibility, sometimes defining the framework along the way.

Invention usually requires engineering or science. An inventor without formal training may experiment in the kitchen or garage, but experimentation is the essence of science. Inventors may be self-taught technologists, but they are technologists all the same.

1.3.4 Prototype Development

Invention can be tested by building a prototype. Like much of science, invention is falsifiable. An inventor often anticipates the limits of the possible and may take years or decades to realize the vision. Eventually, however, the method either yields a functional prototype or it was founded on a mistake. Many organizations are comfortable with their new product development (NPD) process. Once they know what to make or offer they are pretty efficient at producing it. The problem they have is how to capture ideas and evaluate them. The people identified above fulfill this need; however, a key glue person you must have is the Prototyper. Between evaluation and development there is an iterative process—the Prototyper is the master who makes rapid prototyping a reality.

Prototypers rapidly create bare bones versions of your product or service. Their goal is to create enough of the user experience so that real live customers can work with the offering and provide key feedback.

Prototypers have these characteristics:

- Enjoy building mockups and "strawmen": They understand the temporary value of the prototype and how powerful a physical representation of the solution can be to drive new requirements or customer acceptance.
- Are comfortable iterating and building successive prototypes: Often an early prototype leads to requirements or needs that were not previously uncovered, which leads to the need for a new prototype.
- Are good listeners: People who build prototypes need empathy with the customer and their needs. They need to translate what they hear the customer saying (and not saying) into a tangible representation of the product or service.
- Can handle the ejection seat: A key function of prototyping is to rapidly identify what works and what doesn't. Prototypers can handle their role of allowing the organization to fail forward—to recognize and jettison ideas that are unlikely to succeed and thus save valuable time and money that would have been spent developing them.

1.3.5 Testing

If it is true that what gets tested is what gets taught, then in order for creativity to become a priority in the classroom, it must be assessed on par with the testing of more traditional skills and abilities. However, measuring creativity is undoubtedly more complex that measuring literacy or numeracy. While innumerous tests of creativity and creative thinking exist, most of these measure only certain aspects of creativity and frequently, their validity has not been fully tested. Finally, the suggestion has been made that instead of testing creative thinking skills, creative products today are the best predictor of future creative products. Thus, the best method of assessing creativity would involve the review of actual creative output such as student portfolios of creative works, developed over the course of a school year. Piirto agrees: "A more authentic type of assessment would be of actual products. Such a quality assessment could be of a 'creativity portfolio that a student would assemble over the year(s). As an analogy, say there is a boy who can throw a ball from center field to home plate with great and accurate force. Observation would dictate that he would probably do well as a center fielder. Is there any need to give him a paper and pencil test to see whether he has spatial ability?"

1.3.6 Refinement and Perfection

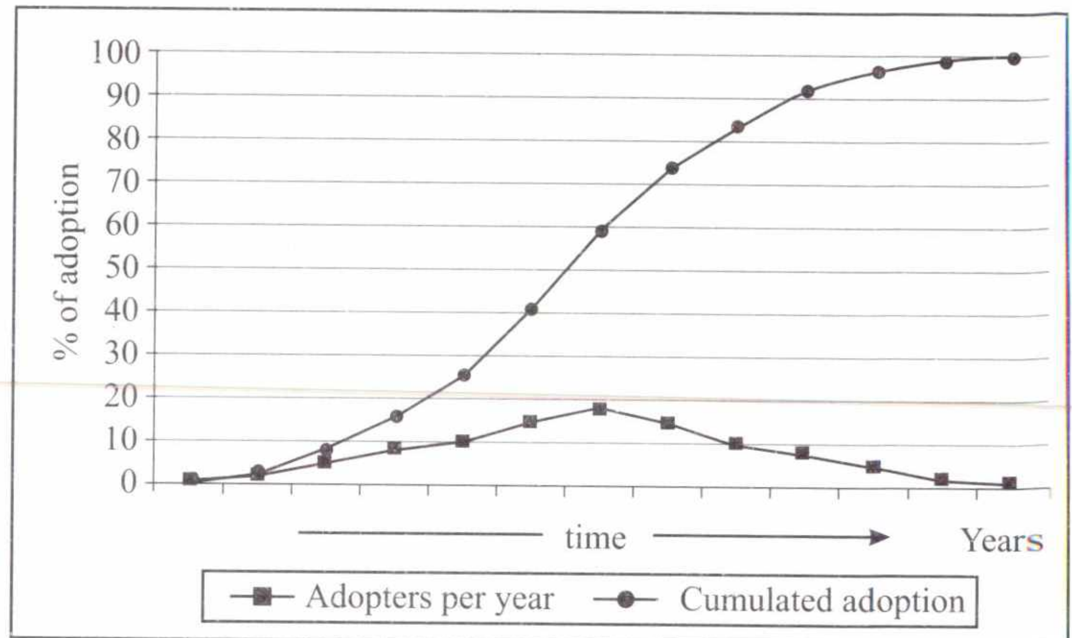
There is no such thing as a perfect product. Companies may run prototype tests and customer studies, but the success of a product cannot be guaranteed until it is eventually launched in the market. The aim is to develop and launch a product/service and continue working towards improvement of its features. Google, for instance, works on the principle of 'launch early and often'. While this gives them the market advantage of being the early innovator, they also understand the pulse of the market quickly and continue working on refining and improving the product. The quest for perfection in innovation, though idealistic, may not always have positive results.

While this could take years for an organisation, the competitor could capture the market first with a similar product, albeit in a beta-testing mode. Time is, therefore, very critical in the innovation process.

NOTES

1.3.7 Diffusion

"Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system", where time is involved in the innovation-diffusion process, innovativeness, and an innovation's rate of adoption. Thus, diffusion depends on four elements: the innovation itself, communication channels, time, and a social system in which diffusion takes place. Under innovation, we understand any new idea, practice or object that is intended to be beneficial for the adopter. Although the explanations for adoption seem to vary between studies, many studies have confirmed that innovation diffusion follows a sigmoid diffusion path over time (see Figure 1.2). However, there is some debate for the reasons behind the shape or the most appropriate functional form.



(adapted from Rogers 1995)

Fig. 1.2: Innovation diffusion overtime

1.4 JAY DOBLIN'S TEN TYPES OF INNOVATION

The Doblin Group studied innovation throughout the world. They identified ten main types of innovation. Sawhney, Wolcott and Arroniz (MIT Sloan Management Review, Spring 2006) identified 12 different ways companies innovate. Both lists are very similar.

NOTES

The following are the 10 types of innovation given by Jay Doblin:

1. **Business Model:** How do you make money? For example; Dell revolutionized the PC business by collecting money before the product was shipped resulting in net positive working capital of seven to eight days.
2. **Networks and Alliances:** How do you join forces with other companies for mutual benefit? For example; Sara Lee realized its core competency was not manufacturing and divested its manufacturing operations, forming alliances to do its manufacturing. Scanlon Leaders formed the Scanlon Leadership Network so they could share best practices and accelerate their development.
3. **Enabling Process:** How do you support your employees? For example; Starbucks, Southwest and Scanlon organizations seek competitive advantage by supporting those closest to the work. Every business has a human component. Companies that help employees understand business reality (Identity), involve employees in decision making (Participation), focus on multiple stakeholders (Equity) and relentlessly improve (Competence) are better at all the other types of innovation.
4. **Core Process:** How do you create and add value? For example; Wal-Mart adds value through core process innovations such as real-time inventory, aggressive volume pricing, and delivery contracts with merchandise providers, etc.
5. **Product Performance:** How do you design your core offerings? For example; Apple provides MP3 Players (I-Pods) that are more expensive and have less features than their competitors. Yet consumers flock to the Apple products because of their elegant designs and ease of use.
6. **Product System:** How do you link and/or provide a platform for multiple products? For example; Microsoft Office bundles a variety of specific products (Word, Excel, PowerPoint, etc) into a system designed to deliver productivity in the workplace.
7. **Service:** How do you provide value to customers and consumers beyond and around your products? For example; an international flight on any airlines will get you to your intended designation. A flight on Singapore Airlines, however, nearly makes you forget that you are flying at all, with the most attentive, respectful, and pampering pre-flight, in-flight and post-services you can imagine.
8. **Channel:** How do you get your offerings to market? For example; Legal problems aside, Martha Stewart has developed such a deep understanding of her customers that she knows just where to be (stores, TV shows, magazines, online, etc.) to drive huge sales volumes from a relatively small set of "home living" educational and product offerings.
9. **Brand:** How do you communicate your offerings? For example; Absolute conquered the vodka category on the strength of a brilliant "theme and

variations" advertising concept, strong bottle and packaging design, and a whiff of Nordic authenticity.

NOTES

10. **Customer Experience:** How do your customers feel when they interact with your company and its offerings? For example; Harley Davidson has created a worldwide community of millions of customers, many of whom would describe "being a Harley Davidson owner" as a part of how they fundamentally see, think, and feel about them.

The Innovation Example of Southwest Airlines:

Southwest Airlines is a very competitive industry. Most of the major players are in bankruptcy or have recently emerged from bankruptcy. Southwest has never failed to produce a profit for its investors, and it is consistently ranked in the top 100 "Best Places to Work." It does not offer Product Performance that is significantly different from any other airline. It competes by being innovative in the following areas:

1. Business Model: Low cost, low frills. Southwest can turn a profit on lower margins than its competitors. It works with the same unions as the other airlines and offers competitive salaries. It reduces costs in other areas of its operations.
2. Network and Affiliations: Southwest has adopted servant leadership and studies and learns from other great Dallas based servant led organizations. Southwest has developed affiliations with professional sports franchises to offer special packages for sporting events.
3. Enabling Process: Southwest has many innovative processes to support their employees. Their Corporate Culture Committees and caring-Servant Leadership provide engaging work for over 30,000 employees.
4. Core Process: Southwest does not have the added cost of major hubs. Southwest is able to turn around their planes at a gate faster than most other airlines. This allows their planes to spend more time in the air and less time sitting on the ground.
5. Service: Southwest is legendary for going the extra mile for its customers, even with a low cost, no frills business model. Employees are empowered to make decisions and to spend money as long as it makes a customer happy. Employees trust that they can make a decision and they will be supported. Southwest makes low cost travelers feel special and appreciated.
6. Channel: Southwest reaches its customers through the internet and through simple advertisements.
7. Brand: Southwest sells "LOVE" and "Freedom" not just airline tickets. When you fly with Southwest you are part of a family, engaged in battle with the giant companies that would try to take away your freedom to fly.

8. Customer Experience: Southwest passengers enjoy humorous and entertaining flight attendants and flight crews. Customers feel the "LOVE" that Southwest markets.

NOTES

1.5 JENNIFER GODDARD'S SIX FOCUS AREAS OF INNOVATION

Innovation is not just about brand new products. There are many places where you can be innovative and often the context helps define innovation.

The six focus areas for innovation are:

1. Product: what we produce and sell
2. Service: exceeding customer expectations
3. Process: continuous improvement of how we do things
4. Management: business strategies, systems and structures
5. Open: working beyond boundaries and collaborating globally
6. Value: creating unique value that eliminates the cost to compete

Looking through this list, consider where you need to focus your innovative efforts right now and write down a couple of project ideas/potential focus areas.

1.6 INNOVATION MODELS OF JOHN BESANT AND JOE TIDD

According to Joe Tidd, John Besant, and Keith Pavitt Innovation is driven by the ability to see connections, to spot opportunities and to take advantages of them. But innovation is not just about opening new markets – it can also offer new ways of serving established and mature ones.

Innovation and Competitive Advantage

What these organizations have in common is that their undoubted success derives in large measure from innovation. Whilst competitive advantage can come from size, or possession of assets, etc. The pattern is increasingly coming to favour those organizations which can mobilize knowledge and technological skills and experience to create novelty in their offerings (product/service) and the way in which they create and deliver those offerings. This is seen not only at the level of the individual enterprise but also increasingly as the wellspring for national economic growth.

Innovation contributes in several ways. For example, research evidence suggests a strong correlation between market performance and new products. New products help capture and retain market shares, and increase that profitability in those markets.

NOTES

In the case of more mature and established products, competitive sales growth comes not simply from being able to offer low prices but also from a variety of non-price factors-design, customization and quality. And in a world of shortening product life cycles-where, for example, the life of a particular model of television set or computer is measured in months, and even complex products like motor cars now take only a couple of years to develop-being able to replace products frequently with better versions is increasingly important, competing in time reflects a growing pressure on firms not just to introduce new products but to do so faster than competitors.

At the same time new product development is an important capability because the environment is constantly changing. Shifts in the socioeconomic field (in what people believe, expect, want and earn) creates opportunities and constraints. Legislation may open up new pathways, or close down others – for example, increasing the requirement for environmentally friendly products. Competitors may introduce new products which represent a major threat to existing market positions. In all these ways firms needs the capability to respond through product innovation.

Whilst new products are often seen as the cutting edge of innovation in the marketplace, process innovation plays just as important a strategic role. Being able to make something no one else can, or to do so in ways which are better than anyone else is a powerful source of advantage.

Types of Innovation

According to Joe Tidd, John Besant, and Keith Pavitt innovation are of four broad categories ('4Ps' of innovation)

- **Product innovation** – changes in the things (products/services) which an organization offers
- **Process innovation** – changes in the ways in which they are created and delivered
- **Position innovation** – changes in the context in which the products/services are introduced
- **Paradigm innovation** – changes in the underlying mental models which frame what the organization does.

Each of our 4Ps innovation can take place along an axis running incremental through to radical change; the area indicated by the circle in Fig1.3 is the potential innovation space within which an organization can operate. Whether it actually explores and exploits all the space is a question for innovation strategy and we will return to it later.

As far as managing the innovation process is concerned, these differences are important. The way in which we approach incremental, day-to-day change will

differ from those used occasionally to handle a radical step change in product or process. But, we should also remember that it is the perceived degree of novelty which matter; novelty is very much in the eye of the beholder. For example, in a giant, technologically advanced organization like shell or IBM advanced networked information systems are commonplace, but for a small car dealership or food processor even the use of a simple PC to connect to the Internet may still represent a major challenge.

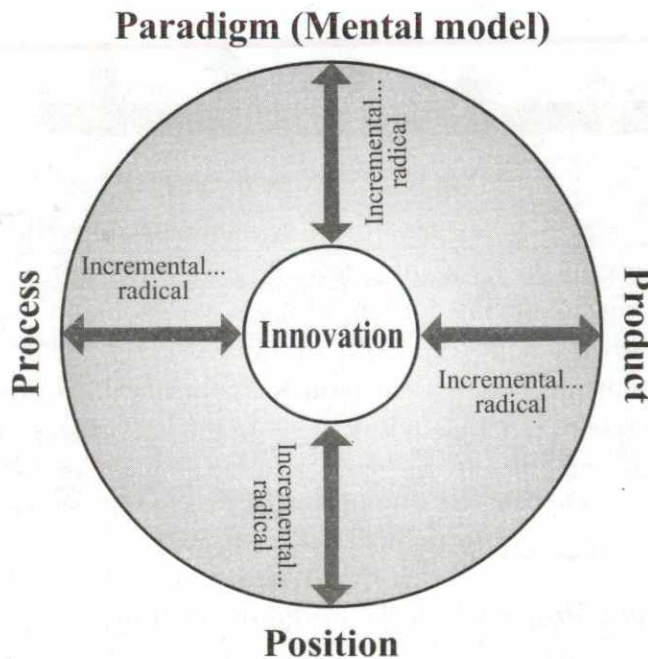


Fig. 1.3: Innovation space

1.7 R&D THE BACK-BONE OF TECHNOLOGICAL INNOVATION

Research and development (R&D) is the process of discovering new technologies that can change and improve the way we live, produce and consume or fine-tuning what is already in the works. Recent examples of technological breakthroughs that have brought transformative changes to our society are the Internet and the associated information and communication technologies. Technological innovation is especially critical for solving environmental challenges. But innovation does not occur in a vacuum. The innovation chain must be supported by government policies, financing, institutions and the participation of the business sector, academia and civil society. At the same time it must be sensitive to the demands and needs of society. In terms of low carbon green growth, innovations should contribute to promoting the eco-efficiency and the development efforts of countries.

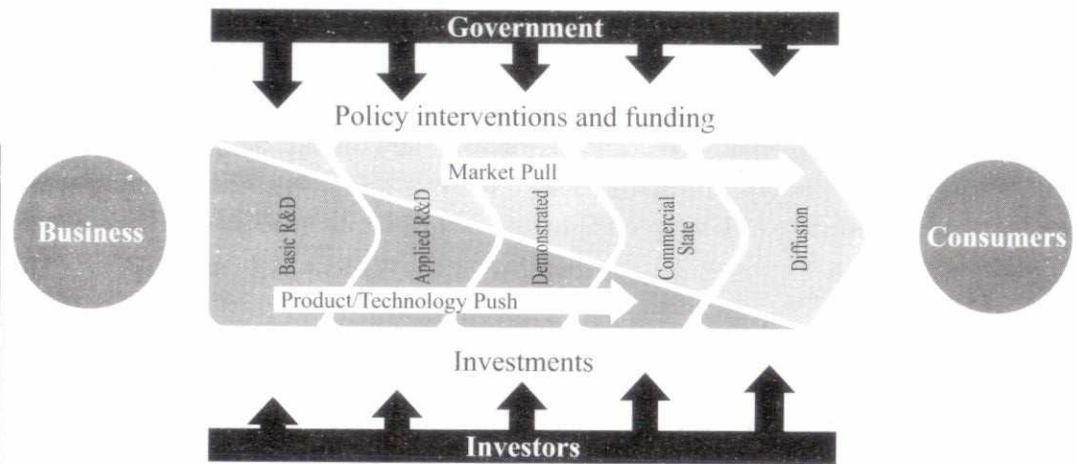


Fig.1.4: Innovation chain

In the early stages of technological development, governments will have a bigger responsibility in terms of prioritizing, implementing policy measures and providing financial support for the technology options. In these early stages, government support is crucial, especially in filling the cost and time gaps, because the investment volume is huge and the returns are long term. For the private sector, the investment risks are too high at this stage. In the later stages of the innovation chain in which the technologies are more mature and close to commercialization, the private sector will have greater involvement. Government-funded R&D should also support or stimulate efforts by the private sector.

Strengths of promoting R&D and technological innovation

- **Addresses environmental challenges:** Technological innovation of low-carbon technologies, including breakthrough technologies, can provide cost-effective solutions for addressing environmental challenges. At the same time, it can also address development goals and improve the quality of life by improving access to energy and safe drinking water, including for the rural poor.
- **Drives economic growth:** New technologies can lead to the creation of new business and investment opportunities and generate employment opportunities. With the increasing resource constraints and volatile fossil fuel prices impacting energy security issues, it is assumed that there will be higher demand for low-carbon technologies, products and services.
- **Strengthens national technology and innovation capacities:** Governments need to establish and strengthen the national innovation and science and technology base, including the institutionalization of national innovation systems and the human resource base. In the long term, this can lead to better capabilities to undertake innovations beyond technology transfer and adoption. Strengthening the innovation systems also means strengthening school curricula, especially in the areas of math and science, as well as setting up university courses that boost the knowledge base and the skills that are necessary to establish a capable workforce.

NOTES

- **Strengthens indigenous innovation capacity for developing technologies applicable to the local context:** Technology transfer may strengthen the general technological absorption and application capacity, which can induce the expansion of the indigenous innovation capacity required to meet local conditions and needs.

Challenges for promoting R&D and technological innovation

- **Absence of national frameworks that promote R&D and technological innovation:** Without a national innovation or industrial strategy, there are no clear short- to long-term policy and price signals for raising the demand for green technology and motivating investors to make the necessary investment decisions.
- **Lack of demand for low-carbon technologies due to market failures:** Market failures that do not incorporate the environmental externalities will not provide the necessary incentives for private sector and consumers to shift their preference towards developing, adopting and purchasing green technology, products and services.
- **Lack of finance directed towards funding national R&D efforts:** R&D efforts for low-carbon technologies require huge investments and the current levels of public financing are not sufficient, even in industrialized countries. According to the International Energy Agency, there is a shortfall of about US$40–$90 billion in public sector low-carbon energy technology spending (currently, it is about US$10 billion) to achieve the goal of 50 per cent CO_2 emissions reduction by 2050.12
- **Lack of innovation capacity:** Developing countries lack the human resources and public institutional capacity to undertake R&D for low-carbon technologies. This is also the case for private companies, including small and medium-sized companies.
- **Regulatory barriers for enabling technological transfer to developing countries:** Developing countries may lack appropriate trade and investment policies, intellectual property rights and enforcement measures.

Shanghai International Business Incubator

With approval of China's Ministry of Science and Technology, the Shanghai International Business Incubator (SHIBI) was established in 1997. Following the organization model of One Incubator, Several Bases, the SHIBI built six incubation bases (research centres), including a headquarters in the Shanghai Technology Innovation Center.

The SHIBI provides an innovative environment and services for domestic and overseas small and medium-sized businesses and functions as a unit that coordinates national and international organizations. To promote international exchange and cooperation, it organizes training programmes and information

Check Your Progress

State the Following Statements are True or False:

4. Invention can be tested by building a prototype.
5. According to Joe Tidd, John Besant, and Keith Pavitt Innovation is driven by the ability to see connections, to spot opportunities and to take advantages of them.
6. Research and development is the process of discovering new technologies that can change and improve the way we live, produce and consume or fine-tuning what is already in the works.

NOTES

exchange sessions and works closely with many organizations within and outside of China, including in France, Japan, Republic of Korea, Russian Federation and the United Kingdom. It has helped Chinese students to establish their own technology business by sharing information and experiences with international enterprises, institutions, R&D centres and companies. It plans to continue offering workshops and seminars for information consultation, matching of partners, market reviews and new technological product distribution and thus stokes technological cooperation between China, other Asian countries and the rest of the world.

Sources: *Wang Rong, Shanghai Hi-tech Business Incubator Network: Networking, Internalization and Professionalization (Shanghai, Shanghai Technology Innovation Center, undated). Available from www.aspa.or.kr/files/webzinevol.10_050907/050907_ASPA%20papaer15_eg.htm (accessed) 12 February 2012); and Shanghai Technology Innovation Center website "About SHIB" (2005). Available from www.incubator.sh.cn/en/aboutshibi.asp (accessed 12 February 2012).*

1.8 R&D AND ECONOMIC DEVELOPMENT NEXUS

(Hasan I, Tucci CL. 2010, The innovation–economic growth nexus: Global evidence. Research Policy 39(10):1264–76.)

Economic growth, especially its long-run sustainability, has long been a focal point of academic researchers and policy makers. Numerous attempts have been made to provide a long list of factors that may have an impact on economic growth. Pioneering work on endogenous growth by Romer 1986, Lucas 1988 and others emphasizes the role of knowledge as an input to production. In their models, it is the technological advancement and industrial innovation that drive long-run growth.

In the models of Romer (1986,1990) and Stokey (1995), among others, industrial innovation activities are an important determinant of economic growth due to their direct impact on the production process and also due to positive externalities. Scholars have also argued that "national innovation systems" – which include aspects of how intellectual property is protected and how research and development (R&D) is funded – is a major contributor to innovation activities.

Several studies attempt to incorporate industrial innovation into models to explain economic growth. Romer (1986) showed that knowledge with increasing marginal productivity could be an input in explaining long-run growth. In a competitive economic environment, intentional investments in innovation activities are motivated by market incentives Treating technological changes as endogenous, Romer (1990) presented a model of the growth rate being determined by the stock of human capital, even though new technology is assumed to be no better than old (horizontal product innovation). In contrast, Aghion and Howitt developed a model in

which vertical innovations make existing products obsolete, becoming the underlying source of growth through a process similar to creative destruction in which demand increases for the superior product, more than compensating at the macro level for the reduction in competitiveness of the product based on the old technology.

The innovation process has its own externalities. The accumulation of technological advancement enlarges the knowledge base and makes sequential innovations available. Knowledge flows and technological spillovers across economic agents benefit all firms including rival firms as well. Even when technological spillovers do not exist, an agent does not appropriate all the social gains from her innovation unless she can price-discriminate. In addition to the efforts made by profit-maximizing firms, academic research funded by public resources in universities and other institutions provides substantial inputs and spillovers into the innovation process.

Innovation activities do not only directly influence economy wide productivity, but also promote economic growth through spurring new business formation, which further promotes employment growth and other outputs. Innovation encourages and facilitates entrepreneurs to create new organizations in order to enter certain industries characterized by an entrepreneurial technological regime. This indirect mechanism has been supported by empirical evidence

Summarizing the above, innovation can be considered important for potential economic growth. So what evidence do we have that it is linked to growth, and at what levels of analysis? Various studies have been conducted at the level of individual firms, industries, as well as countries. Cameron (1998) surveys the existing literature on this topic and concludes that the majority of these studies find a positive link between innovation and some measures of output.

Meanwhile, many other studies attempt to investigate the spillover effects of innovation. For example, Coe and Helpman (1995) and Bayoumi et al. (1999) have documented that international trade can greatly raise a country's total factor productivity.

There are many reasons for this, but one factor could very well be knowledge transfer due to international trade. However, there is a limitation for such spillovers across countries. Audretsch and Feldman (1996) find that innovation spillovers tend to be localized in the sense that industries with a prevalence of knowledge spillovers have a high propensity to be clustered. For example, there may be important barriers to knowledge flow even between European countries.

The above leads to the following two hypotheses:

- H1- The higher the level of innovative activity, the higher the rate of economic growth in an economy.
- H2- The higher the quality of innovative activity, the higher the rate of economic growth in an economy.

1.9 TYPES OF INNOVATORS

Innovation connotes something that is essentially new, however to create business value, it does not necessarily have to be 'new to the world'. It can be new to an industry, or new to your customers, or a new advance to your internal processes and hence cost reducing. It can be a new business model. Clearly it can be new products, services, technologies, or processes. And there is no value in it being new for the sake of being new. It must be new (meaning different to some extent) and value creating to be a successful innovation.

Basically the innovators can be classified into following categories:

1.9.1 Technology Innovators

The countries which do not have a strong science and technology base have often to import technology for manufacturing a variety of products for meeting their needs. Often state of the art technologies are not available and even if they are available, they may not be accessible and affordable. The absorption and adaptation of technologies pose problems for technology importers. Further, even if such problems are resolved, it is important that firms make continuous improvement through R&D to ensure competitive advantage.

1.9.2 Business Model Innovators

Business model innovators are always seeking out places and events with a strong design vibe. They love to hang around really smart design thinkers and the places they hang out in hopes that some of it will rub off. Business-model innovation captures the essence of this type of innovation without ambiguity. Business-model innovation is the discovery of a fundamentally different business model in an existing business. For example, Amazon and Barnes & Noble compete in the book retail business in fundamentally different ways. Similarly, Charles Schwab, easyJet, and Dell compete in their respective industries in substantially different ways from their competitors, such as Merrill Lynch, British Airways, and HP (or IBM).

It is important to note that business model innovators do not discover new products or services; they simply redefine what an existing product or service is and how it is provided to the customer. For example, Amazon did not discover bookselling; it redefined what the service is all about, what the customer gets out of it, and how the service is provided to the customer. Similarly, Swatch did not discover the watch; it redefined what this product is and why the customer should buy it.

1.9.3 Process Innovators

Process innovation became an important topic with the rise of the quality and continuous improvement movements and, then again, with the more recent attention directed at change management, organizational learning and knowledge management.

Corporations today, at least in the developed world, are reaching the limits of incremental process improvement. Some have argued that what is needed today is radical process innovation. Hammer and Champy (1994) introduced the concept of radical reengineering based on their assertion that for companies to achieve maximum efficiency and effectiveness requires radical process re-engineering of the organization and its processes. Because processes lag far behind what is possible given technological advancement, it is not possible to achieve the necessary transformation through incrementalism.

1.10 SUMMARY

- The term innovation may be defined as a process by which varying degrees of measurable value enhancement is planned and achieved, in any commercial activity.
- Innovations are broadly divided into technological innovations, product innovations, process innovations and management innovations.
- West and Farr (1990) define innovation as follows: "the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society".
- Creativity is the ability to produce new and original ideas and things. Creativity is synonymous with inventiveness. R&D and innovation are creative processes. Creativity brings new ideas or concepts into being.
- Most literature on creativity and innovation in the workplace targets an audience of managers and business leaders and focuses on methods to foster organizational climates conducive to innovation.
- Scientific temper is an attitude of applying logic and avoidance of preconceived ideas. In simple terms we can say that scientific temper includes the creative thinking
- Invention usually requires engineering or science. An inventor without formal training may experiment in the kitchen or garage, but experimentation is the essence of science.
- Invention can be tested by building a prototype.
- Diffusion depends on four elements: the innovation itself, communication channels, time, and a social system in which diffusion takes place.
- The Doblin Group studied innovation throughout the world and identified ten main types of innovation such as business model, networks and alliance, enabling process etc.
- Jennifer Goddard's six focus areas for innovation are product, service, process, management, open and values.

- According to Joe Tidd, John Besant, and Keith Pavitt Innovation is driven by the ability to see connections, to spot opportunities and to take advantages of them.
- Research and development (R&D) is the process of discovering new technologies that can change and improve the way we live, produce and consume or fine-tuning what is already in the works.
- In the models of Romer (1986, 1990) and Stokey (1995), among others, industrial innovation activities are an important determinant of economic growth due to their direct impact on the production process and also due to positive externalities.

1.11 KEY TERMS

- **Innovation:** Innovation means the development of a new idea and implementing the established ways of doing things for common use.
- **Creativity:** Creativity is the ability to produce new and original ideas and things.
- **Scientific temper:** Scientific temper is an attitude of applying logic and avoidance of preconceived ideas.
- **Diffusion:** Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system

1.12 ANSWERS TO 'CHECK YOUR PROGRESS'

1. technology
2. creative
3. Motivation
4. True
5. True
6. True

1.13 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Define innovation.
2. What are the key requisites of innovation?
3. What are the Jay Doblin's 10 types of innovation?
4. Describe the Jennifer Goddard's six focus areas of innovation.

Long-Answer Questions

1. Write a note on innovation model of John Besant and Joe Tidd.
2. Discuss the concept of R&D and technological innovation.
3. Write a note on R&D and economic development nexus.
4. What are the different types of innovators?

NOTES

NOTES

UNIT 2 INNOVATION AND HUMAN INTELLECT

Structure

2.0 INTRODUCTION

Business ventures have some common factors amongst themselves. But they need to have some unique selling proposition (USP) to survive. It is for arming the business with a USP that organizations need to innovate. Innovation helps a business house to survive when the winds of change hit the market; in fact, innovation fuels the winds of change. Innovation is not just creation of new ideas/ thoughts, but it is also about translating them into products/services. Hence innovation can be defined as the successful exploitation of new ideas - incorporating new technology, design and best practices is the key business process that enables the businesses to compete effectively.

2.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Explain creative process of innovation

- Discuss the techniques of transforming creativity into invention and invention into innovation.
- Define sources of innovation.

2.2 CREATIVITY AND PROBLEM SOLVING

Creative problem solving is the mental process of creating a solution to a problem. It is a special form of problem solving in which the solution is independently created rather than learned with assistance. Creative problem solving always involves creativity. However, creativity often does not involve creative problem solving. Commercial organisations, to an extent, will always depend upon spontaneous creative activities of members. These cannot be planned, although we have seen that it is within the power of management to increase the probability of their occurrence. Their number may be small but occasionally they are of such significance that a company or industry will be transformed.

R&D resources are allocated to find answers to questions such as: How can we satisfy this particular market need? How can this new technology be turned into a profitable application in the form of product or process? How can we resolve this specific problem?

The answers to these questions normally leave little to chance, but the success of the project initiated to meet these needs depend largely upon the quality of ideas or concepts upon which they are based.

An efficient problem solving takes place when managers have various viable, creative alternatives to consider. To motivate employees to approach problems creatively and to initiate a creative environment, the organizations follow the following general approaches:

- hiring creative individuals
- applying specific creativity-enhancement techniques
- developing a creative organization
- Simply the creative behaviour may be identified as production of ideas that are both new and useful. These definitions may seem constraining, since in some case the usefulness may not be immediately evident. One scholar has addressed this dilemma by differentiating between originality and creativity. Both motivation and a proper setting may be necessary if innate creative ability is to blossom into creative output.

The following are the important techniques of creative problem solving:

Heuristics

The heuristic technique is developed to get the best possible answer or optimal solution. A heuristic as a noun is a "rule of thumb" an educated guess, an intuitive

judgment or simply common sense. It is a general way of solving a problem. In simple terms, heuristics stands for strategies using readily accessible though loosely applicable, information to control problem solving in human beings and machines.

For example, it may be argued that the most fundamental heuristic is "trial and error" which can be used in everything from matching bolts to bicycles to finding the values of variables in algebra problems.

Here are few other commonly used heuristics from Polya's (1945) book, how to solve it

1. If you are having difficulty in understanding a problem, try drawing a picture.
2. If you can't find a solution, try assuming that you have a solution and seeing what you can derive from that (working backward).
3. If the problem is abstract, try examining a concrete example.
4. Try solving a more general problem first (the "inventor paradox": the more ambitious plan may have more chances of success).

Brainstorming

Brainstorming is one of the most popular techniques used to induce creativity and so deserves special mention. Brainstorming was originally suggested by the classic creativity studies guru, Alex Osborn in his 1957 book, Applied Imagination. However, the technique is often implemented correctly. Studies show that due to evaluation apprehension and blocking, fewer ideas are generated in brainstorming groups than would be generated if participants thought alone and wrote ideas down. To be done correctly, brainstorming sessions should first involve 15-20 minutes for people to think individually and write their ideas on an anonymous piece of paper which is then handed in to the facilitator. All ideas are then discussed openly with a view to first considering how each one could be feasible rather than the more common approach of seeking to criticize or find the reasons why it wouldn't work.

In the Brainstorming session, a multiplication of ideas is sought. The rules are as follows:

1. No ideas are ever criticized.
2. The more radical the ideas are the better.
3. The quantity of idea production is stressed.
4. The improvement of ideas by others is encouraged.

Brainstorming, which emphasizes group thinking, was widely accepted in business circles.

Synectics

Synectics is summarised as "making the strange familiar and making the familiar strange".

Although normally considered as a creativity technique or process, synectics can also be considered a state of mind or even a philosophy. It is essentially about combining entities be those entities people, existing ideas or even physical objects.

2.3 THE CREATIVE PROCESS

Most people use the word 'creativity' quite freely without pausing to think about the process by which the act or idea they describe as creative came about. From experience you know that our judgment is largely subjective, coloured by the extent to which the solution has surprised us because it was not what we would have expected. Nevertheless it is possible to identify a number of features frequently found in those ideas we describe as creative.

Many definitions of creativity stress the part played by imagination in generating new concepts or unusual solutions to problems. Schon, for example, describes invention as 'a non-rational process". Other writers' widen the definition to embrace analytical techniques based upon systematic search methods.

Creative thinking often takes the form of cross-fertilization between related fields. One of the most significant examples may be taken from the career of Charles Darwin. Darwin saw a connection between his work in botany and biology and the work of others in the field of human population trends. Population scholars have reached the conclusion that human population tends to increase faster than available food supplies, thus causing a struggle for existence.

Creativity involves more than the sudden moment of inspiration in which an idea suddenly flashes in the brain. Instead, as shown in Fig. 2.1 below, there are four stages to the creative process: preparation, incubation, insight, and verification.



Fig. 2.1: Phases of creative process

Preparation

Preparation involves gathering, sorting, and integrating information and other materials to provide a solid base for a later breakthrough. The discoveries of penicillin, the benzene ring, or gravity, while each involved a moment of insight, would have been impossible without a firm grasp of related information.

Incubation

During the incubation stage, the mind is not consciously focused on the problem. The individual may be relaxed, asleep, reflective, or otherwise involved.

Insight

The insight stage is the familiar, sudden moment of inspiration. While this is what we often think of as creativity, it is only one step in the creative process.

Verification

Finally, verification is necessary. Here, the individual carries out the chores involved in carefully checking facts to support the insight, carrying out research to determine that the DNA molecule is in fact a double helix or that a meteorite did really create a dust cloud that led to the extinction of the dinosaurs. This process further supports the contention that creativity does not just happen. It is a thorough and often-painstaking activity.

2.4 INTELLECT AND CREATIVITY

Sternberg's article, "Creativity and Intelligence" in the Handbook of Creativity, provides an overview of the multitude of theories that have been proposed concerning the relationship between creativity and intelligence. While there is no consensus on the subject, multiple theories provide insight.

Ultimately, Sternberg promotes a '"triarchic theory", asserting that there are three main aspects of intelligence that are key for creativity — synthetic, analytical and practical:

1. **Synthetic (creative)***:* the ability to generate ideas that are novel, high quality and task appropriate. One aspect of this is the ability to redefine problems effectively and to think insightfully. Sternberg also notes that the basis for insightful flunking involves knowledge acquisition in three forms:
   (i) *Selective encoding:* distinguishing relevant from irrelevant information.
   (ii) *Selective combination:* combining bits of relevant information in novel ways.
   (iii) *Selective comparison:* relating new information to old information in novel ways.
2. **Analytical:** Critical-analytical thinking is involved in creativity as the ability to judge the value of one's own ideas, to evaluate their strengths and weaknesses and suggest ways to improve them.
3. **Practical:** Ability to apply intellectual skills in everyday contexts and to sell creative ideas.

In his article, "Creative Thinking in the Classroom' Sternberg stresses the importance of these three types of flunking to overall to intellectual functioning and successful intelligence. The analytic and practical are separate from and support the synthetic. Studies indicate that when students were taught in a way that emphasized all three

abilities, they significantly outperformed students taught in a way that emphasized only analytical abilities. The holistic approach also increased performance on strictly analytical, memory-related questions.

NOTES

Sternberg also explains, "Because the analytical, synthetic and practical aspects of abilities are only weakly related, students who are adept in one of these areas might not benefit particularly from instruction aimed at another area, and in particular, creative students might not benefit particularly well from instruction as it is given in the schools, which typically emphasizes memory and analytical abilities." In an experiment, they found that "high school students who were taught in a way that better matched their own pattern of abilities tended to achieve at higher levels than students who were taught in a way that more poorly matched their pattern of abilities"

The cognitive processes suggested within Sternberg's synthetic dunking category appear and reappear within the literature. Although a range of vocabulary is used to describe the phenomena, it is clear that the central, agreed-upon component of creative thinking is the ability to combine existing elements of knowledge or understanding in new ways. Simonton research on the concept of creative Darwinism also provides insight into this aspect of the creative thinking processes. Creative Darwinism asserts that creativity is a stochastic combinatorial process under which multiple ideational variations emerge in an individual's mind, and then subsets of them are selected for preservation and execution. This concept was first put forward in 1960 by David Campbell, an evolutionary epistemologist. Simonton believes that Campbell's model "still provides the best framework for a comprehensive theory of creativity." The concept asserts that creativity requires the capacity to generate blind variations in the same sense that genes might generate random mutations and that this generation is not linked to the probability of success of any given variation. The implication is that if creativity requires blind variation, then it is conceivable that creative performance may be increased by any technique that might serve to break the stranglehold of conventional expectations and simply increase the number of randomly generated variations. Some experiments have shown that this type of stimulation is indeed possible. This supports the idea that "if the variation process is truly blind, then good and bad ideas should appear more or less randomly across careers, just as happens for genetic mutations and recombination." The theory thus implies that the creative mind can be enhanced by environments or efforts that encourage the individual to generate new variations and new combinations of ideas.

Simonton's historiometric studies of creative individuals support this concept. The data shows that quality of creative output is closely connected to sheer quantity. The more an individual produces, the more likely he/she is to stumble upon success. Also, the best creative products tend to appear at the point in a creator's career when he/she is most prolific overall. Thus, in the case of both the arts and sciences,

Check Your Progress

Fill in the Blanks:

1. .... is a special form of problem solving in which the solution is independently created rather than learned with assistance.
2. Brainstorming, which emphasizes..........., was widely accepted in business circles.
3. Creative thinking often takes the form of .... between related fields
4. .... involves gathering, sorting and integrating information and other materials to provide a solid base for a later break through.

NOTES

creative quality is a "probabilistic consequence of quantity and the pattern of output is random and Poisson distributed". As Simonton explains, "the total lifetime output of a nineteenth century scientist predicts the probability that he or she will have an entry in a twentieth-century edition of the Encyclopedia Britannica (Dennis, 1954a; Simonton, 1984b). Similarly, future Nobel laureates can be predicted on the basis of the total number of citations that scientists receive to their body of work (Ashton & Oppenheim, 1978), and yet the single best predictor of citations is the total number of publications (S. Cole & J. R. Cole, 1973; Simonton, 2002). It is significant that those who publish the most highly cited works also publish the most ignored works, so that quality is a probabilistic consequence of quantity,".

2.5 CREATIVE INDIVIDUALS AND OUT-OF-BOX THINKING

Innovative people are free thinkers, they are dreamers, but they also turn their dreams into reality. They are perceptive and observant. They are able to look at situations from new, different unconventional perspectives. They can think about something that is unthinkable for others. They are able to see things which others have overlooked. They generally have strong intuitions and gut feelings.

Creativity Profile

People who display a high degree of creativity tend to be:

1. Optimistic about the future
2. Open to alternatives
3. Daydreamers
4. Highly curious and observant
5. Independent thinkers
6. Able to recognize and break bad habits
7. Good at turning innovative ideas into practical solutions
8. Adventurous, with multiple interests
9. Constantly exposing themselves to new ideas and information
10. Willing to take risks and unwilling to let Scars hold them back
11. Open to new experiences
12. People who take action and make things happen
13. Full of commitment to what they are doing
14. Nonconformists

Source: *Burus, Daniel (1993), Technotrends, Harper Business, p.210*

Not surprisingly, the research supports the view that creative people are intelligent, although some studies indicate little correlation between creativity and intelligence above an IQ level of about 120. The view widely held is that highly intelligent persons are not necessarily creative since the intelligence may make them overly self-critical. Though many forms of creativity require substantial intelligence, many people are capable of creative actions with appropriate training and self-discipline. MacKinnon, after a review of several studies, states that we may have overestimated in our education system the role of intelligence in creative achievement.

Mackinnon describes the picture of the creative individual emerging from these studies in the following terms:

The more creative a person is the more he reveals openness to his own feelings and emotions, a sensitive intellect and understanding, self awareness and wide-ranging interests.

His findings suggest that: Creative persons are relatively uninterested in small details, or facts for their own sake, and more concerned with their meanings and implications, possessed of considerable cognitive flexibility, verbally skilful, interested in communicating with others and accurate in so doing, intellectually curious and relatively disinterested in policing either their own impulses and images or those of others.

2.6 TECHNIQUES OF TRANSFORMING CREATIVITY INTO INVENTION AND INVENTION INTO INNOVATION

Edward de Bono, the British Physician and Psychologist developed the lateral thinking method. The lateral thinking method is a deliberate process and set of techniques for generating new ideas by changing an individual's or team's way of perceiving and interpreting information. The lateral thinking method includes several techniques for (a) developing an awareness of current ideas and practices; (b) stimulating alternative ways of looking at a problems; and (c) aiding in the development of new ideas. For fostering the development of new ideas, three techniques namely reversal, analogy and cross-fertilization are considered important.

1. **Reversal Technique:** A reversal technique involves examining the problems by turning it completely around, inside out or upside down. E.g., prudential insurance considered the idea of paying the death benefits to people suffering from terminal illnesses before they die, calling this as "living benefit life insurance". Prudential insurance has sold more than a million such policies.
2. **Analogy Technique:** The analogy technique involves developing a statement above similarities among objects, persons and situations. E.g., the systems work like a clock. If somebody ignores the dynamic business environment

while talking about future plans, an analogy that might be relevant is – we are like an ostrich with our heads buried in the sand.

3. **Cross-fertilization Technique:** The cross-fertilization technique involves asking experts from other fields to view the problem and suggests methods for solving it. To be effective these experts are to be drawn from various disciplines that are entirely different from the discipline where the problem exists.
4. **Brainstorming Technique:** This technique was developed by Alex F. Osborn, who is fondly known as the father of brainstorming. The purpose of this approach is to improve problem solving by finding new and unusual solutions. In the brainstorming session, a multiplication of ideas is sought. The rules are as follows:

- No ideas are ever criticized.
- The more radical the ideas are the better.
- The quantity of idea production is stressed.
- The improvement of ideas by others is encouraged.

Brainstorming, which emphasizes group thinking, was widely accepted in business circles.

2.7 SOURCES OF INNOVATION

Cognitive psychology provides the most prolific and developed perspective on the sources of individual creativity. In 1950, J.P. Guilford, then President of the American Psychological Association, stated in his presidential address that the topic of creativity deserved greater attention. Following this seminal call to action, psychological research on creativity expanded significantly. These efforts have concentrated on the cognitive processes behind creativity, the characteristics of creative people, the development of creativity across the individual life span, and the social environments most conducive to creativity.

Teresa Amabile, PhD in Psychology and Head of the Entrepreneurial Management Unit at the Harvard Business School, has provided the field with one of the most simple and yet comprehensive frameworks for the topic. Creativity arises through the confluence of the following three components:

1. **Knowledge:** All the relevant understanding an individual brings to bear on a creative effort.
2. **Creative Thinking:** Relates to how people approach problems and depends on personality and thinking working style.
3. **Motivation:** Motivation is generally accepted as key to creative production, and the most important motivators are intrinsic passion and interest in the work itself.

Peter Drucker wrote that there are seven sources of innovation. The following are the key sources of information:

NOTES

1. Unexpected Events

Unexpected events can be failures as well as successes. For example, the failure of the technically superior Sony's Betamax VCR standard (and the success of the industry standard VHS format) led the firm to pay more attention to developing products in line with industry standards. Similarly, the development of the very successful Sony Walkman was the result of the CEO spending time in New York and noticing young people carrying portable radios on their shoulders. Progressive Insurance saw its business quadruple in size when it started sending claims adjusters in mobile offices to accident scenes.

2. Incongruities

Incongruities result from a difference between perception and reality. Federal Express was able to capitalize on consumer dissatisfaction with the U.S. Postal Service and demonstrate that individuals and companies were willing to pay a premium for overnight delivery of packages and documents.

Likewise, Southwest Airlines provided a dramatically different approach to airline service. Its low-fare, no-frills, first come-first seated approach has garnered devoted customers. Southwest Airlines has remained profitable for 31 straight years, even during the economic downturn following the terrorist attacks of 2001, when many airlines struggled to remain in business.

3. Process Needs

Process need innovations are those which are created to support some other process or product. The development of the ATM (Automatic Teller Machine) and now web-based and Internet banking options allow individuals to do their banking when the bank is closed and without relying on tellers being available. This has freed tellers from performing many routine functions such as cashing checks and has improved both efficiency and profit margins for banks.

4. Market and Industry Structure Changes

Industry structures change in response to growth and changes in the marketplace. One of the most dramatic changes can be seen in the healthcare industry. The rise of HMOs (Health Maintenance Organizations) and the decline of the traditional fee-for-service plans have impacted the healthcare industry as a whole. The development of the personal computer also had a far-reaching impact on the computer industry as a whole. Until the personal computer, manufacturers of large mainframe computers, terminals, and software developed for specific uses within a firm dominated the computer industry. With the adoption of the personal computer and advent of the laptop computer, the composition of computer sales and marketing changed dramatically.

5. Demographic Changes

Demographic changes are shifts in the makeup of the population. Increases in the

Hispanic and Asian populations in the United States create opportunities for new products and services, such as cable television stations targeting these audiences. Innovations in prepared meals and takeout food are meeting the needs of busy two-income families and single-parent families.

6. Changes in Perception

Americans have become more health conscious and we have seen the rise in popularity of stores such as GNC which cater to the demand for vitamins and other supplements. Similarly, stores such as Whole Foods provide organic produce, meats, dairy, and fish free from additives to satisfy a growing market demand for chemical-free products.

7. New Knowledge

New knowledge or technology is one of the strongest forces for innovation. Many companies, of all sizes and levels of sophistication, now have a web presence on the Internet with the capability of connecting their products with customers nearby or on the other side of the globe. No longer are consumers limited to the daytime hours for their activities; online stock trading, shopping, and banking are examples of services that are accessible at any time of day or night via the Internet. Other opportunities are being explored in the fields of genomics and nanotechnology. These technologies and systems will develop even further as consumers continue to demand new and innovative products and immediate access to information, goods and services.

2.8 MICHAEL LEE SCRITCHFIELD'S 4 P'S OF CREATIVITY/INNOVATION

Creativity as a whole entity, or a single field to be studied, is composed of four parts or strands. They were described by Rhodes (1961) as being: understanding the traits, characteristics or attributes of the creative person; describing the operations or stages of thinking used in the creative process; identifying outcomes and qualities of creative products; and examining the nature of situations and its context within the creative press (or environment).

1. Product

Almost as big as the universal question of, What is creativity?, is the question, How do I know it is creative? That it refers to a product, or outcome, irrespective of what that product is. The product may be an idea, a song, a fractal algorithm, a race car or a recipe à tangible or intangible it doesn't matter. It can come from any and all sorts of human endeavor. These products or outcomes may be created by a group of people or an individual, and can have a fluctuating range of both usefulness and novelty. Creative products or outcomes, as described by Besemer & O'Quin (1987), have three characteristics. They are: novelty, describes the originality or newness of

the product (originality, germinality, and transformality); resolution, how the product addresses the challenge it was created for; synthesis, how the product goes beyond just addressing the challenge.

2. Process

The creative process really concerns itself with how creativity occurs. It examines the thinking stages or operations that happen when people behave in a creative manner. Most of the early research focused on how highly creative people described the mental process that they went through to create whatever products they created. Wallas (1926) described the creative process and suggested that it has four stages. They are: preparation, examining the challenge in all directions; incubation, thinking about the problem in a not-conscious manner; illumination, the emergence of a happy idea; and verification, a validity check on the idea and refining it to a more precise form.

3. Person

In the early days of creativity research psychologists and most others were very interested in the people who demonstrated an ability to be creative. This explains why most of the early work in this field was concentrated on the person. There are two burning questions surrounding creativity in a person. They are: How creative am I?; and How am I creative?

The first examines the level of creativity that is in each person. This is one of the basic precepts that everyone in the field of creativity knows to be true every person is creative. There are some creativity assessments that can be used to measure the level of creativity in a person. The best know and most widely accepted is the Torrance Tests of Creative Thinking (TTCT).

The TTCT measures the creative originality, elaboration, fluency and flexibility of the person assessed. The second question is concerned with the style of the creative person. The creativity assessments that are best know and most used to identify a person's style are the Kirton Adaption-Innovation Inventory (KAI) and the Myers-Briggs Type Indicator (MBTI).

The KAI measures thinking style and relates whether a person is either an adaptor or an innovator. The MBTI measures four separate scales on a paired either-or assessment. The pairs are: extraversion-introversion; sensing-intuition; thinking-feeling; and perceiving-judging. Through research it has been determined that there are some tangible characteristics, or abilities, of a creative person. They are, but not necessarily limited to: fluency, capacity to make order from chaos, curiosity, elaboration, openness, risk-taking, flexibility, tolerance of ambiguity, originality, complexity, imagination, independence.

Torrance (1979) created a model for studying and predicting creative behavior in people. The model included: abilities, like the ones mentioned above; skills, which relates to creativity skills such as recognizing and applying strategies for creating;

NOTES

and motivation, one's personal commitment to creative pursuits. Where all three intersect in the model is the focal point of highest creative behavior.

4. Press

Creative press refers to the environment the person is in, or the product is produced, or the process occurs. It is concerned with the climate and everything that affects the climate where creativity takes place. This is where creativity and creative behavior can flourish or be fatally hindered. VanGundy (1985) identified three categories that affect a group's creative climate. They are: internal, external and interpersonal relationships. Internal relates to one's personal perceptions of the external climate. The external are the factors, physical and other, that exist all around the person, product or process. Interpersonal relationships with others are self explanatory. Goran Ekvall of the Swedish Employment Security Council developed, through research, ten dimensions that are related to creative climate or environment. They are: challenge and motivation; freedom; dynamism; trust and openness; idea time; playfulness and humor; conflict; idea support; debates; and risk-taking. All but one of these dimensions have a positve correlation to the creative climate. That means when they are present and supported then the climate or environment is more likely to enhance creativity. The one dimension that has a negative correlation to the creative climate is conflict. The more conflict there is the less possibility there is for the climate to enhance creativity.

2.9 4 ZONE'S OF INNOVATION

Innovation isn't confined to break-out, market-creating, blockbuster products and services. There are innovation types available for each phase of the category life cycle, from growth through maturity and decline, to end of life. The innovation types for each life cycle phase are grouped according to four value disciplines that identify strategies which can be activated to achieve new offerings, increased customer service, cost efficiency, and improved portfolio management. In Dealing with Darwin, Moore also maps innovation strategies to two primary business architectures: complex-systems and volume-operations. Considering innovation along these two lines allows a company to select its most effective strategy.

The single most important act of strategy leadership is to select the innovation vector upon which your company will develop its sustainable competitive advantage—its core. To do this properly requires a deeper understanding of the properties of each of these innovation types.

Moore identifies five life cycle categories for products and services: emergent, growth, maturity, decline, and end of life. Disruptive innovation, the type of innovation which is most often associated with high technology, occurs in the emergent category. This phase is described in his book, Crossing the Chasm, and involves the leap from early adopters to mainstream buyers where it enters the growth phase. Although

disruptive innovation is highly desirable, it is not the only type of innovation available to companies. Innovation types span the entire category life cycle and can contribute to overall corporate growth. In Dealing with Darwin, Moore devotes one chapter to each life cycle phase and its innovation strategies. This model of innovation broadens your outlook on opportunities for growth and new offers.

Moore overlays the category maturity lifecycle with the four value disciplines described by Michael Treacy and Fred Wiersema in The Discipline of Market Leaders. The four disciplines are: product leadership, customer intimacy, operational excellence, and category renewal.

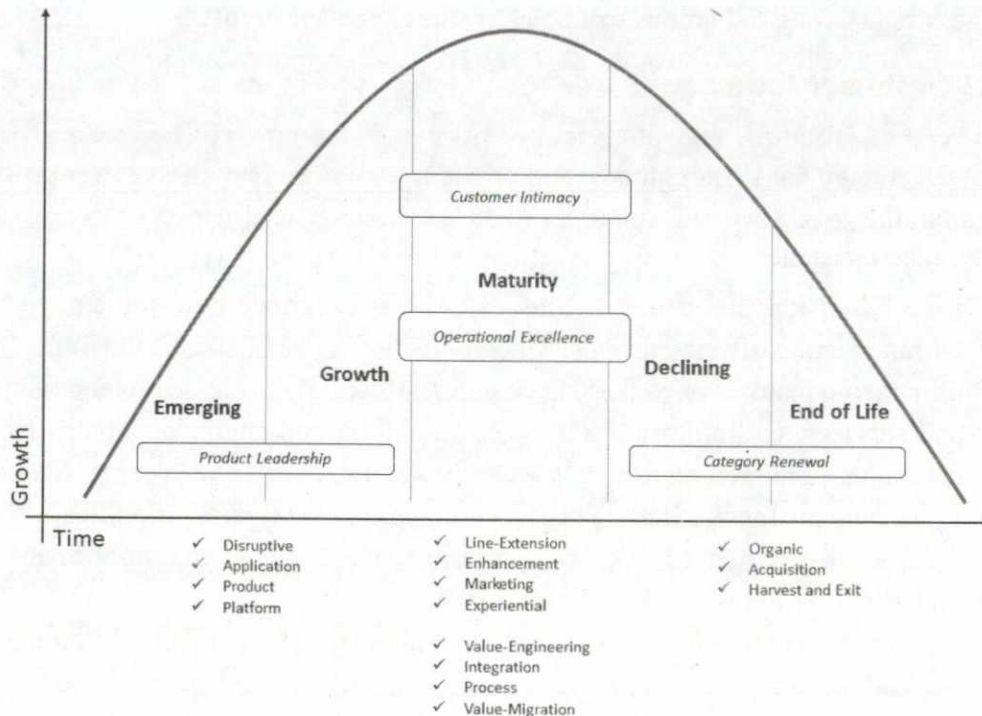


Fig. 2.2: 4 zones of innovation

2.9.1 Product Leadership

This group of innovation types is characterized as very powerful, expensive and risky. Therefore, they must be executed in high growth markets to realize the necessary returns and market share wins.

- Disruptive Innovation – Products and services which create technology discontinuities and new market categories are part of this set. Existing standards and value chains are over-turned in favor of new approaches. Digital media (music, film) and social media networks are examples.
- Application Innovation – Finding new uses, new audiences, and re-combining existing functionality are attributes of this category. Although standards change, existing value chains are disrupted. Examples from the book are the application

of Macintosh computers to desktop publishing and using fault tolerant computers to run ATM networks.

- Product Innovation – Here, existing products are improved through functionality and usability for existing markets. Success is achieved through time to market and patent protection. Improvements such as wireless connnectivity in laptops, cameras in cell phones, and hybrid engines in cars are examples of product innovation.
- Platform Innovation – Platform leaders create foundational or ingredient systems on which third parties can build further value. Success here relies on architectural leadership, relationship building, and creating benefits for the entire ecosystem. Famous examples are Intel and Microsoft.

2.9.2 Customer Intimacy

This type of group of innovation is less risky and less powerful, but can give a company money back through cost and efficiency savings. Due to its lower power potential, this group is better suited for mature markets where market share is more likely to be constant.

- Line-Extension Innovation – Line-extensions introduce new sub-categories within existing offering groups. Much of the infrastructure stays the same, but user-facing features or packaging changes sufficiently to create novel products and services. Examples are SUVs for an auto manufacturer or laptops for a computer manufacturer.
- Enhancement Innovation – This is a smaller, more targeted, modification or feature enhancement to an existing offering such as Teflon coating for pans or higher pixel ratings for digital cameras.
- Marketing Innovation – Marketing innovation uses new or highly effective marketing campaigns such as viral strategies, social media, or crowd sourcing to outpace competitors.
- Experiential Innovation – This category occurs most frequently in service offerings, or by adding a service to an existing product. Here the overall experience of a offering is enhanced through personalization, 1:1 attention, or a higher level of value add.

2.9.3 Operational Excellence

Like Customer Intimacy, the Operational Excellence zone is less risky and less powerful, but can give company money back through cost and efficiency savings. Due to its lower power potential, this group is better suited for mature markets where market share is more likely to be constant.

- Value-Engineering Innovation – The goal in this category is to decrease costs in manufacturing / development for existing offers without changing their composition. Optimizing component parts and the overall assembly / creation process are tactics here.

Check Your Progress

Fill in the Blanks:

5. .... is concerned with the climate and everything that affects the climate where creativity takes place.
6. The Kirton Adaption - Innovation Inventory (KAI) measures .... and relates whether a person's either an .... or an investor.
7. Torrence (1979) created a model for .... and creative behaviour in people.
8. .... group of innovation is less risky and less powerful, but give a company money back through cost and efficiency savings.

- Integration Innovation – This is the flip-side of value-engineering innovation– the customer's cost of ownership is decreased by simplification and/or consolidation into a single entity that can be managed more effectively than multiple pieces.
- Process Innovation – The goal of this type of innovation is to reduce waste and cost from processes that support and enable the offer, rather than offer itself. Inventory management and quality programs can be used here.
- Value-Migration Innovation – This type of innovation is described in Adrian Slywotzky's book Value Migration. Companies taking this approach will move away from segments of the value chain which are commoditized to segments which are richer in profit and growth opportunities.

2.9.4 Category Renewal

Category renewal considerations come into play when a business is declining and must be wound down or immediately exited.

- Organic Innovation – Re-positioning a company to a growth category is the goal of organic innovation. Examples are IBM moving from hardware/software to services and Microsoft moving into browser software.
- Acquisition Innovation – This strategy equates to mergers and acquisitions, either as a buyer or seller.
- Harvest and Exit – This decision effectively closes out a line of business.

2.10 INNOVATION FAILURES

Innovators face problems and challenges mainly in the areas of financial assistance and marketing of their innovation. In other words, it involves:

- Securing the right kind of finance is key to delivering innovation. Prevailing asymmetry between inventors and investors is required to be bridged. Financing systems for backing up early-stage innovations with risk capital are required. Also, provisions for exiting from non-profitable innovations also need to be made.
- Innovations created at the expense of considerable investment of resources, demand a matching Intellectual Property Rights (IPR) regime.
- The legal framework for protecting IPR is in place but the infrastructure for capturing and protecting IPR is still evolving in India.
- New approaches, programmes and policies are essential for unleashing India's innovation potential.
- Competitiveness innovation cluster has emerged as a successful global concept, in which academia, research and industry partner under viable and equitable pattern, are the way forward.

Innovations that fail are often potentially good ideas but have been rejected or

NOTES

postponed due to budgetary constraints, lack of skills or poor fit with current goals. Failures should be identified and screened out as early in the process as possible. Early screening avoids unsuitable ideas devouring scarce resources that are needed to progress more beneficial ones. While learning is important, high failure rates throughout the innovation process are wasteful.

The causes of failure have been widely researched and can vary considerably. Some causes will be external and others will be internal. Internal causes of failure relate to those associated with the innovation process itself. Common causes of failure within the innovation process in most organisations can be divided into five types:

- Poor goal definition
- Poor alignment of actions to goals
- Poor participation in teams
- Poor monitoring of results
- Poor communication and access to information

Gaining full benefits of innovation requires an effective and efficient framework across a wide range of policy areas, calling for an integrated approach and cooperation between business, governments and society.

2.11 SUMMARY

- Creative problem solving always involves creativity. However, creativity often does not involve creative problem solving.
- R&D resources are allocated to find answers to questions such as: How can we satisfy this particular market need? How can this new technology be turned into a profitable application in the form of product or process? How can we resolve this specific problem?
- An efficient problem solving takes place when managers have various viable, creative alternatives to consider.
- The heuristic technique is developed to get the best possible answer or optimal solution.
- Brainstorming is one of the most popular techniques used to induce creativity and so deserves special mention.
- Synectics is a creativity technique that is closely related to Brainstorming. The main difference is that synectics is more formalized and rigorous than brainstorming.
- Creativity involves more than the sudden moment of inspiration in which an idea suddenly flashes in the brain. There are four stages to the creative process: preparation, incubation, insight, and verification.
- Innovative people are free thinkers, they are dreamers, but they also turn their dreams into reality. They are perceptive and observant. They are able to look at situations from new, different unconventional perspectives.

- Creativity arises through the confluence of the following three components:
  - Knowledge: All the relevant understanding an individual brings to bear on a creative effort.
  - **Creative Thinking:** Relates to how people approach problems and depends on personality and thinking working style.
  - **Motivation:** Motivation is generally accepted as key to creative production, and the most important motivators are intrinsic passion and interest in the work itself.
- Creativity as a whole entity, or a single field to be studied, is composed of four parts or strands. They were described by Rhodes (1961) as being: understanding the traits, characteristics or attributes of the creative person; describing the operations or stages of thinking used in the creative process; identifying outcomes and qualities of creative products; and examining the nature of situations and its context within the creative press (or environment).
- The four disciplines are: product leadership, customer intimacy, operational excellence, and category renewal.
- Innovations that fail are often potentially good ideas but have been rejected or postponed due to budgetary constraints, lack of skills or poor fit with current goals.

2.12 KEY TERMS

- **Heuristic:** The heuristic technique is developed to get the best possible answer or optimal solution.
- **Brainstorming:** Brainstorming is one of the most popular techniques used to induce creativity and so deserves special mention.
- **Creative problem solving:** Creative problem solving is the mental process of creating a solution to a problem.
- **Line-Extension Innovation:** Line-extensions introduce new sub-categories within existing offering groups.
- **Marketing Innovation:** Marketing innovation uses new or highly effective marketing campaigns such as viral strategies, social media, or crowd sourcing to outpace competitors.

2.13 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Creative problem solving
2. group thinking
3. cross-fertilization
4. preparation

5. Creative press
6. thinking style, adaptor
7. Studying; Predicting
8. Customer intimacy

2.14 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Define creative problem solving.
2. What are the key techniques of creative problem solving?
3. What are the different phases of creative process?
4. Write a note on intellect and creativity.

Long-Answer Questions

1. What are the key characteristics of creative individuals?
2. What are the key sources of innovation?
3. What are the Michael Lee Scritchfield's 4 P's of innovation?
4. What are the 4 zones of innovation?
5. What are the key reasons for innovation failure?

UNIT 3 THEORIES OF CREATIVITY, INNOVATION, TECHNOLOGY AND R&D

Structure

3.0 INTRODUCTION

According to Conventional wisdom, creativity is something done by creative people. Even creativity researchers, for several decades, seemed to guide their work by this principle, focusing predominantly on individual differences: What are creative people like, and how are they different from most people in the world? Although this person-centered approach yielded some important findings about the backgrounds, personality traits, and work styles of outstandingly creative people (e.g., Barron, 1955; 1968; MacKinnon, 1962;1965), it was both limited and limiting. The approach

offered little to practitioners concerned with helping people to become more creative in their work, and it virtually ignored the role of the social environment in creativity and innovation.

NOTES

In this unit we will study some key theories and strategies related to innovation and creativity.

3.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Explain behavioral theory of R&D investment and innovation
- Discuss open innovation theory
- Define brinnovation (breakthrough innovation).

3.2 BEHAVIORAL THEORY OF R&D INVESTMENT AND INNOVATION

Firm's decision on search and risk taking has been the core interest of organizational decision making process. Specifically, the behavioral theory of the firm emphasizes the organizational processes of performance evaluation, search, and decision making (Cyert & March 1963). This behavioral perspective claims that decision makers use an aspiration level to evaluate firm performance, and that the gap between their own performance and the aspiration level influences their behavior toward search and risk taking. Prior studies adopting this perspective mainly support that performance below the aspiration level induces risk taking while performance above the aspiration level leads to risk aversion (Baum, Rowley, Shipilov, & Chuang 2005; Cyert & March 1963; Greve 1998; 2003; Kahneman & Tversky 1979).

Firm's decision on search and risk taking has been the core interest of organizational decision making process. Specifically, the behavioral theory of the firm emphasizes the organizational processes of performance evaluation, search, and decision making (Cyert & March 1963). This behavioral perspective claims that decision makers use an aspiration level to evaluate firm performance, and that the gap between their own performance and the aspiration level influences their behavior toward search and risk taking. Prior studies adopting this perspective mainly support that performance below the aspiration level induces risk taking while performance above the aspiration level leads to risk aversion (Baum, Rowley, Shipilov, & Chuang 2005; Cyert & March 1963; Greve 1998; 2003; Kahneman & Tversky 1979).

Theory and Hypotheses

Organizational change involves risk whether it is about increasing the search intensity or actually pursuing new strategic actions. According to the behavioral theory of the firm, decision makers interpret organizational performance by comparing it

with social and historical aspiration levels and these aspiration levels influence the firm's decision on change (Cyert & March 1963). Thus, risk taking depends on specific goals and the behavior differs by actors' position whether they are above or below the aimed aspiration level (Greve 1998; March 1988; March & Shapira 1992). In particular, Kahneman and Tversky (1979) contend that individual's risk taking appears to increase when people fail to attain a goal or aspiration level. Also in business situations, managers tend to report taking fewer risks when performance exceeds their goals (March & Shapira 1987; Singh 1986) and high organizational risk taking is associated with low performance relative to aspirations (Bolton 1993; Bowman 1982; Bromiley 1991). Prior research has shown that the negative association between risk taking and performance is applicable to firm's decision on R&D intensity because R&D corresponds to the search stage of the behavior theory of the firm which suggests search and innovation launch jointly contribute to the risky firm innovations (Greve 2003). That is, the problemistic search is stimulated when organizational performance is below the aspiration level, resulting in increased R&D.

3.3 OPEN INNOVATION THEORY

Open innovation means that the company needs to open up its solid boundaries to let valuable knowledge flow in from the outside in order to create opportunities for co-operative innovation processes with partners, customers and/or suppliers. It also includes the exploitation of ideas and IP in order to bring them to market faster than competitors can. Open innovation principles therefore describe how to deal best with strategic assets in order to meet market demands and company requirements. The open innovation approach is about gaining strategic flexibility in the strategic process and creating a critical momentum in innovation diffusion in order to generate customer acceptance and create industry standards.

Determinants of Open Innovation

Besides keeping the processes and capabilities of open innovation in mind, the determinant perspective helps to configure the innovation system. Open innovation can be summarised as an approach that enriches companies' innovativeness, but also limited to companies with special products or industry characteristics. The following discussion of open innovation companies' general characteristics can help managers to decide whether this approach can improve their innovativeness and therefore gain them competitive advantage.

A high product modularity is one required characteristic with which to exploit the advantages that an open innovation approach provides. Companies in modularised types of manufacturing industries such as Kone, Thyssen and Otis can increase their innovativeness by opening up their innovation process. For companies within the chemical industry, like Novartis, with a low modularity, the advantages of an open

NOTES

innovation approach are limited. Industry speed is another characteristic that can indicate whether companies can gain an advantage from open innovation. Industries such as companies providing network technology and services, e.g. Cisco, can gain a huge advantage by integrating external knowledge, or through co-operative innovation processes with partners. On the other side of the spectrum, companies with a low industry speed, like providers of building materials, e.g. YTONG, do not need to focus on faster innovation processes. Also the tacit knowledge required to innovate and the complexity of interfaces are characteristics that are important to gain advantage by means of an open innovation strategy. Nike, as a sport clothes manufacturer, has a low demand for tacit knowledge as well as a low interface complexity, which enables the company to outsource its production to China. Companies like Bühler (grain milling process) or MTU and Pratt & Whitney (aerodynamic design of rotors in turbines) are characterised by the high degree of tacit knowledge required for their innovation, combined with a high complexity of interfaces. They can therefore use the open innovation approach to increase their innovativeness.

Companies that can use positive external effects (spillovers) by licensing their IP, as the IBM case and companies in the chemical industry (e.g., Solvay, BASF), illustrate, are predestined to determine the inside-out process as a core process within their open innovation strategy. Table 3.1 summarises the characteristics identified as core to gain an advantage from an open innovation approach. Besides these core characteristics of industries and companies predestined to use an open innovation approach to increase their innovativeness, it is important to take into account whether the open innovation core process will take place in a bilateral or multilateral relationship with the chosen partner.

Table 3.1

Open Innovation Approach	Closed Innovation Approach
• high product modularity • high industry speed • much explicit and tacit knowledge required • highly complex interfaces • creating positive externalities	• low product modularity • low industry speed • less tacit knowledge required • low complex interfaces • no positive external effects through licensing

3.4 DOMINANT DESIGN THEORY

The notion of a "dominant design" has a substantial history in research on economics, management, strategy and innovation. In the earliest elaborations of the concept, Utterback and Abernathy (1975), Abernathy (1978), Sahal (1985) defined the dominant design as a single architecture that acquires dominance in a product market. Such dominance essentially effects standardization. In later work, Suarez and Utterback (1995) allow that the dominant design is more than simply a technical

standard-indeed often dominant designs are conceptualized as bundles of standards that work at the subcomponent level, rendering a final product architecture that satisfies the needs of most users. Afuah & Utterback (1997) utilize this architectural notion of dominant design and postulate that dominant design consists of standardized components interacting through standardized engineering interfaces. Christensen et al. broaden and refine the definition of a dominant design as the concepts that define how the components of the product interact or relate to each other.

Management scholars have used the notion of dominant design as a marker for identifying the period in an industry's evolution in which a shift from one dynamic to another occurs. The concept of dominant design was central to Abernathy and Utterback's (1978) model of industry evolution based on a shift from product to process innovation. In Anderson and Tushman's (1990) model of industry evolution, the dominant design marks the transition from an era of technological ferment to one of incremental improvements on the dominant design. Their model distinguishes radical innovations from dominant designs, proposing that a discontinuous innovation ushers in a period of experimentation, which ceases with the emergence of the dominant design. In this characterization of industry evolution, a dominant design emerges through a variation-selection-retention dynamic, which poses real, albeit poorly understood, challenges for managers (Anderson & Tushman 1990). Dominant design has also helped shape the strategy literature on entry timing (e.g., Lieberman & Montgomery 1998; Mitchell 1989; Tegarden et al. 1999).

While the dominant design concept is not always considered in the organizational ecology literature, that literature has used the idea of a dominant architectural solution to demarcate period effects in its model of industry dynamics (e.g. Carroll & Hannan 1995; Wade 1995). Once more the themes associated with the dominant design model emerge, e.g. a period of high rates of experimentation with technical and organizational architectures, ultimately followed by a period of concentration and lower levels of variation, etc. The very idea that legitimation drives the process of selecting a dominant design, and with that, a recognition that this may not be the most efficient or effective solution, is consistent with classic dominant design logic (e.g., Abernathy 1978).

3.5 TECHNOLOGY S-CURVE THEORY

The S-Curve emerged as a mathematical model and was afterwards applied to a variety of fields including physics, biology and economics. It describes for example the development of the embryo, the diffusion of viruses, the utility gained by people as the number of consumption choices increases, and so on.

In the innovation management field the S-Curve illustrates the introduction, growth and maturation of innovations as well as the technological cycles that most industries experience. In the early stages large amounts of money, effort and other

NOTES

resources are expended on the new technology but small performance improvements are observed. Then, as the knowledge about the technology accumulates, progress becomes more rapid. As soon as major technical obstacles are overcome and the innovation reaches a certain adoption level an exponential growth will take place. During this phase relatively small increments of effort and resources will result in large performance gains. Finally, as the technology starts to approach its physical limit, further pushing the performance becomes increasingly difficult, as the figure below shows.

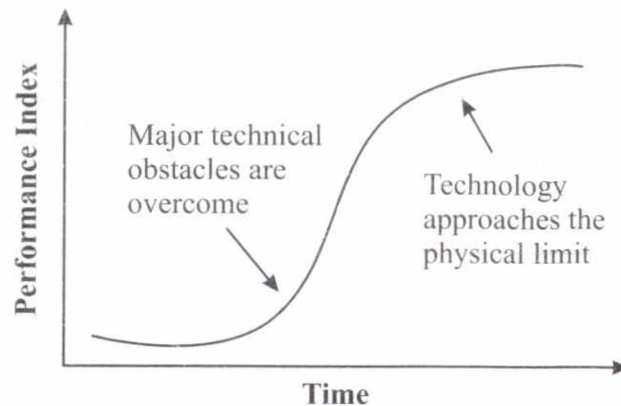


Fig. 3.1

Consider the supercomputer industry, where the traditional architecture involved single microprocessors. In the early stages of this technology a huge amount of money was spent in research and development, and it required several years to produce the first commercial prototype. Once the technology reached a certain level of development the know-how and expertise behind supercomputers started to spread, boosting dramatically the speed at which those systems evolved. After some time, however, microprocessors started to yield lower and lower performance gains for a given time/effort span, suggesting that the technology was close to its physical limit (based on the ability to squeeze transistors in the silicon wafer). In order to solve the problem supercomputer producers adopted a new architecture composed of many microprocessors working in parallel. This innovation created a new S-curve, shifted to the right of the original one, with a higher performance limit (based instead on the capacity to co-ordinate the work of the single processors).

Usually the S-curve is represented as the variation of performance in function of the time/effort. Probably that is the most used metric because it is also the easiest to collect data for. This fact does not imply, however, that performance is more accurate than the other possible metrics, for instance the number of inventions, the level of the overall research, or the profitability associated with the innovation.

One must be careful with the fact that different performance parameters tend to be used over different phases of the innovation, as a result the outcomes may get mixed together, or one parameter will end up influencing the outcome of another. Civil aircraft provides a good example, on early stages of the industry fuel burn was a

Check Your Progress

Fill in the Blanks:

1. The open innovation approach is about gaining .... in the strategic process and creating a critical momentum in innovation diffusion in order to generate customer acceptance and create industry standards.
2. The .... emerged as a mathematical model and was afterwards applied to a variety of fields including physics, biology and economics.
3. Management scholars have used the notion of .... as a marker for identifying the period in an industry's evolution in which a shift from one dynamic to another occurs.

negligible parameter, and all the emphasis was on the speed aircrafts could achieve and if they would thus be able to get off the ground safely. Over the time, with the improvement of the aircrafts almost everyone was able to reach the minimum speed and to take off, which made fuel burn the main parameter for assessing performance of civil aircrafts.

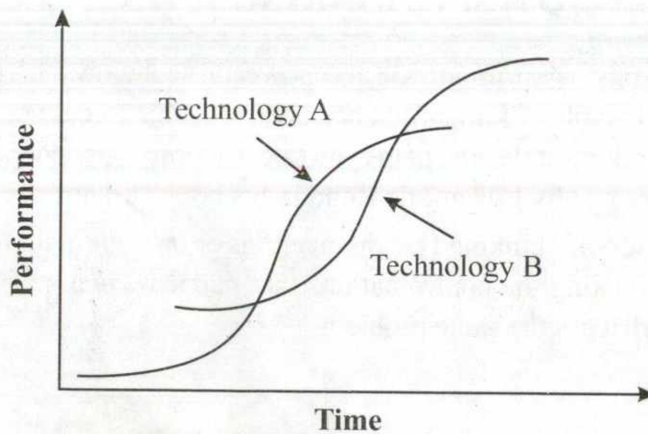


Fig. 3.2

Overall we can say that the S-Curve is a robust yet flexible framework to analyze the introduction, growth and maturation of innovations and to understand the technological cycles. The model also has plenty of empirical evidence, it was exhaustively studied within many industries including semiconductors, telecommunications, hard drives, photocopiers, jet engines and so on.

3.6 BRAINSTORMING THEORY

Brainstorming is one of the most popular techniques used to induce creativity and so deserves special mention. Brainstorming was originally suggested by the classic creativity studies guru, Alex Osborn in his 1957 book, Applied Imagination. However, the technique is often implemented correctly. Studies show that due to evaluation apprehension and blocking, fewer ideas are generated in brainstorming groups than would be generated if participants thought alone and wrote ideas down. To be done correctly, brainstorming sessions should first involve 15-20 minutes for people to think individually and write their ideas on an anonymous piece of paper which is then handed in to the facilitator. All ideas are then discussed openly with a view to first considering how each one could be feasible rather than the more common approach of seeking to criticize or find the reasons why it wouldn't work.

In the Brainstorming session, a multiplication of ideas is sought. The rules are as follows:

1. No ideas are ever criticized.
2. The more radical the ideas are the better.
3. The quantity of idea production is stressed.

NOTES

4. The improvement of ideas by others is encouraged.

Brainstorming, which emphasizes group thinking, was widely accepted in business circles.

3.7 ED DEBONO'S SIX THINKING HATS

'Six Thinking Hats' is an important and powerful technique. It is used to look at decisions from a number of important perspectives. This forces you to move outside your habitual thinking style, and helps you to get a more rounded view of a situation. This tool was created by Edward de Bono in his book '6 Thinking Hats'.

You can use Six Thinking Hats in meetings or on your own. In meetings it has the benefit of blocking the confrontations that happen when people with different thinking styles discuss the same problem.

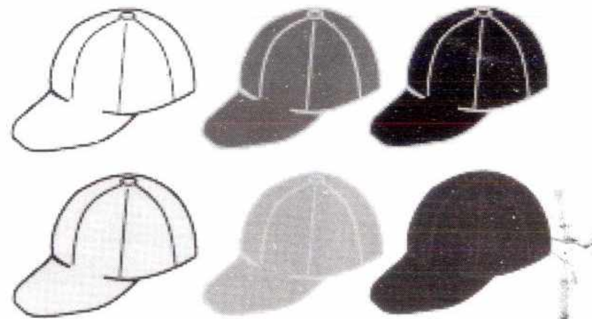


Fig. 3.3

Each 'Thinking Hat' is a different style of thinking. These are explained below:

1. With this thinking hat you focus on the data available. Look at the information you have, and see what you can learn from it. Look for gaps in your knowledge, and either try to fill them or take account of them.

   This is where you analyze past trends, and try to extrapolate from historical data.

2. 'Wearing' the red hat, you look at problems using intuition, gut reaction, and emotion. Also try to think how other people will react emotionally. Try to understand the responses of people who do not fully know your reasoning.

3. Using black hat thinking, look at all the bad points of the decision. Look at it cautiously and defensively. Try to see why it might not work. This is important because it highlights the weak points in a plan. It allows you to eliminate them, alter them, or prepare contingency plans to counter them.

4. Black Hat thinking helps to make your plans 'tougher' and more resilient. It can also help you to spot fatal flaws and risks before you embark on

a course of action. Black Hat thinking is one of the real benefits of this technique, as many successful people get so used to thinking positively that often they cannot see problems in advance. This leaves them under-prepared for difficulties.

5. The yellow hat helps you to think positively. It is the optimistic viewpoint that helps you to see all the benefits of the decision and the value in it. Yellow Hat thinking helps you to keep going when everything looks gloomy and difficult.
6. The Green Hat stands for creativity. This is where you can develop creative solutions to a problem. It is a freewheeling way of thinking, in which there is little criticism of ideas. A whole range of creativity tools can help you here.
7. The Blue Hat stands for process control. This is the hat worn by people chairing meetings. When running into difficulties because ideas are running dry, they may direct activity into Green Hat thinking. When contingency plans are needed, they will ask for Black Hat thinking, etc.

A variant of this technique is to look at problems from the point of view of different professionals (e.g. doctors, architects, sales directors, etc.) or different customers.

Example:

The directors of a property company are looking at whether they should construct a new office building. The economy is doing well, and the amount of vacant office space is reducing sharply. As part of their decision they decide to use the 6 Thinking Hats technique during a planning meeting.

Looking at the problem with the White Hat, they analyze the data they have. They examine the trend in vacant space, which shows a sharp reduction. They anticipate that by the time the office block would be completed, that there will be a severe shortage of office space. Current government projections show steady economic growth for at least the construction period.

With Red Hat thinking, some of the directors think the proposed building looks quite ugly. While it would be highly cost-effective, they worry that people would not like to work in it.

When they think with the Black Hat, they worry that government projections may be wrong. The economy may be about to enter a 'cyclical downturn', in which case the office building may be empty for a long time. If the building is not attractive, then companies will choose to work in another better-looking building at the same rent.

With the Yellow Hat, however, if the economy holds up and their projections are correct, the company stands to make a great deal of money. If they are lucky, may be they could sell the building before the next downturn, or rent to tenants on long-term leases that will last through any recession.

NOTES

With Green Hat thinking they consider whether they should change the design to make the building more pleasant. Perhaps they could build prestige offices that people would want to rent in any economic climate. Alternatively, maybe they should invest the money in the short term to buy up property at a low cost when a recession comes.

The Blue Hat has been used by the meeting's Chair to move between the different thinking styles. He or she may have needed to keep other members of the team from switching styles, or from criticizing other peoples' points.

Source: http://www.mindtools.com/pages/article/newTED_07.htm

3.8 COMBINATION METHOD

Combination innovation is to combine more than two technology elements together and get a new product. Those technology elements are usually substance unit, techniques, principles, structures, functions and so on.

Because the existing technology elements have been applied in different domains, combination of those technology elements is a method with large possibility. The idea from combination innovation is more feasible. According to the characteristics of combination innovation, it can be classified into 6 types. They are listed below.

- **Technology combination:** It means to combine the different technology elements to get a new performance of a product.
- **Material combination:** Different materials are combined together to get a new material with new character. The new material always can meet the new engineering requirement.
- **Product combination:** More than two products are combined to get a new product with more functions.
- **Suit combination:** In order to get a new portable product, the products with different standards can be combined based on the structure re-design.
- **Function combination:** Many different functions are combined together to get a new product with multi-function.
- **Structure combination:** Based on the structure re-combination, a new product with compound function can be gotten.

Example: A special alloy with shape-memory function can be gotten with the combination of 'titanium' and 'nickel'.

3.9 BRINNOVATION (BREAKTHROUGH INNOVATION)

Breakthrough innovations are generally considered "out-of-the-blue" solutions that cannot be compared to any existing practices or techniques. These innovations employ new technologies and create new markets.

Most breakthroughs are developed by R&D groups who often have not thought specifically about a particular commercial market application. These technologies originate on the supply side of supply chain. Conventional wisdom says listen to the market, but breakthroughs come from labs that do not have what the customer wants in mind. These technologies are then pushed onto the consumer. For example, Tim Berners-Lee, a software engineer, created a network of interconnected computers to share and distribute information easily and cheaply in 1980. This network developed into the Internet. Tim never thought about what customers wanted when he created his network.

The interaction between research, marketing and development groups can be detrimental. In general, most marketing professionals view marketing as getting a grasp on what customers need. They do not emphasis educating customers about the usefulness of technology or creating a new market. Therefore, R&D groups must make a marketing group understand how useful the technology will be. R&D groups must be visionary and lead the other groups in productizing the technology. R&D groups should encourage marketing groups to seek new markets for the developed technology.

Marketing professionals have a tendency to ask customers, "Hey, do you think you need this technology?" In general, customers are ignorant of the benefits of a new technology and cannot visualize how it will help them solve problems. Just imagine what the average Joe would have said about the usefulness of the Internet in 1991, when it was first conceptualized! Customers can only start visualizing once they are thoroughly educated about the benefits of a product. As an example, hardly anyone appreciates the iPhone until they actually use it. If Apple's marketing people had approached customers two years back and asked whether they needed an iPhone or not, customers would have said, "There are so many other phones available with the features that you are talking about. I don't think anybody would want to buy your phone!" Now, the iPhone is very successful. Customers don't realize that they need breakthrough technologies unless they actually get a first hand experience.

Standard market research tools are not very useful in determining the market size for breakthrough technologies. Determining the ideal price and business model is difficult in most cases.

3.10 BENCHMARKING

Robert Camp (1989) defines benchmarking as "the search for those best practices that will lead to the superior performance" of a unit or organization. It can help you to find effective practices at other organizations for services in which your unit is not providing the level of quality, satisfaction, or efficiency you would like to see. The emphasis is on studying the practices and processes of recognized leading organizations to find out how they do what they do, rather than gathering results and 'bottom line' data and trying to match or beat those.

NOTES

Benchmarking is not limited to the collection of numbers and comparison of averages, nor is it a one-time effort. It's not a test to see whether your unit is measuring up. It's a means to gather information and then target areas and processes for improvement.

There are three types of benchmarking:

- Process benchmarking involves identification of best practices.
- Strategic benchmarking involves identifying emerging trends in a market or industry for strategic or resource planning.
- Comparative benchmarking is results oriented, and can be useful in setting stretch goals.

The Phases of Benchmarking

Like many other organizational initiatives, effective benchmarking begins with preparation, and moves through several phases.

Phase One: Identifying and examining your own processes

- Which processes are most critical to your success?
- Which processes provide the greatest opportunities for improvement?
- How these processes are currently performed? Can you map the processes?
- How is the performance of these processes currently measured? Can measures be developed if they are not currently in place?

Phase Two: Identifying the organizations with which you will benchmark, and how data will be collected

- What organizations or units are known within your professional network or field as highly effective in regard to the services, products, or processes you would like to benchmark?
- What organizations have been recognized publicly for their accomplishments in the services, products, or processes you would like to benchmark?
- What questions would you like answered based on your analysis of your own processes?
- Do you need personal contact to get these answers, or can it be provided in writing?

Phase Three: Collecting and analyzing the data

Once data is collected, the task is to compare performance levels and practices, and identify performance gaps in your organization.

- Where are the similarities and differences in practices and processes?
- What can you apply or adapt in your unit from the other organizations' approaches?
- What ideas for new approaches, services, or products are triggered by what you learn about other organizations' approaches?

Phase Four: Establishing targets to close the gaps and developing action plans to reach those targets.

- What are your future performance goals and measures for the targeted processes?
- What innovations or improvements do you want to implement to reach these targets?
- What support or challenges exist for these changes?
- Who should be involved in planning and carrying out this implementation to maximize its success?

Phase Five: Implementing the action plans and tracking progress toward the goals.

- What are the milestones for implementation?
- How frequently should you measure performance? Monthly? Quarterly? Are there seasonal or semester variations?

3.11 COMPLEXITY THEORY

Complexity is defined as the measure of heterogeneity or diversity in internal and environmental factors such as departments, customers, suppliers, socio-politics and technology (Mason 2007: 10). Complexity theory focuses on how parts at a micro-level in a complex system affect emergent behavior and overall outcome at the macro-level (McElroy, 2000: 198; McKenzie and James, 2004: 35). It is concerned with the study of emergent order in what otherwise may be considered as very disorderly systems (Sherif, 2006: 73). As the complexity of a system increases, the ability to understand and use information to plan and predict becomes more difficult. Over time, the increasing complexity leads to more change within the system (Chakravarthy, 1997: 74). As the system becomes more complex, making sense of it becomes more difficult and adaptation to the changing environment becomes more problematic (Mason, 2007: 11; Cao and McHugh, 2005: 477). Complexity theory paradigm rejects the mechanical ontological models, which assume linear causality between events and effects (Styhre, 2002: 346; Ferlie, 2007: 156; Mason, 2007: 22). According to Rhee (2000: 488), the characteristic structural and behavioral patterns in a complex system are due to the interactions among the system's parts. Complex systems tend to be deterministic in nature and evolve through a phase of instability, which eventually reaches another threshold where a new relationship is established between its internal and external environments and itself (Sullivan, 2004: 46; McElroy, 2000: 197). Systems that operate near a threshold of instability tend to exhibit creativity and produce new and innovative behaviors at the level of the whole system (Price, 2004: 44; Styhre, 2002: 347).

Some proponents of complexity theory employ the concept of entropy. A simple definition for entropy is disorder. It is the tendency of a system to move toward a more

NOTES

random state in which there is no further potential for energy transformation or work (McKenzie and James, 2004: 33; Byeon, 2005: 224; Farazmand, 2003: 341). Entropy is the disorder, disorganization, lack of patterning, or randomness of organization of a system (Byeon, 2005: 224). According to Bailey (1990: 71), entropy has replaced the age of equilibrium. The concept of equilibrium as espoused in systems theory is not sufficient to fully describe the complexity of social phenomena. Complexity theory is able to grasp the dynamic processes of the generic entropy phenomena in organizations and society at large (McElroy, 2000: 198; Meek et al., 2007: 30; Rhee, 2000: 488; Byeon, 2005: 225).

3.12 TRIZ/TRIP THEORY

"TRIZ" is the (Russian) acronym for the "Theory of Inventive Problem Solving." G.S. Altshuller and his colleagues in the former USSR developed the method between 1946 and 1985. TRIZ is an international science of creativity that relies on the study of the patterns of problems and solutions, not on the spontaneous and intuitive creativity of individuals or groups. More than three million patents have been analyzed to discover the patterns that predict breakthrough solutions to problems, and these have been codified within TRIZ.

TRIZ is spreading into corporate use across several parallel paths – it is increasingly common in Six Sigma processes, in project management and risk management systems, and in organizational innovation initiatives.

TRIZ research began with the hypothesis that there are universal principles of creativity that are the basis for creative innovations, and that advance technology. The idea was that if these principles could be identified and codified, they could be taught to people to make the process of creativity more predictable. The short version of this is:

Somebody someplace has already solved this problem (or one very similar to it.) Today, creativity involves finding that solution and adapting it to this particular problem.

The three primary findings of the last 65 years of research are as follows:

- Problems and solutions are repeated across industries and sciences. By classifying the "contradictions" in each problem, you can predict good creative solutions to that problem.
- Patterns of technical evolution tend to be repeated across industries and sciences.
- Creative innovations often use scientific effects outside the field where they were developed.

Much of the practice of TRIZ consists of learning these repeating patterns of problems-solutions, patterns of technical evolution and methods of using scientific effects, and then applying the general TRIZ patterns to the specific situation that confronts the developer. Figure 3.4, describes this process graphically.

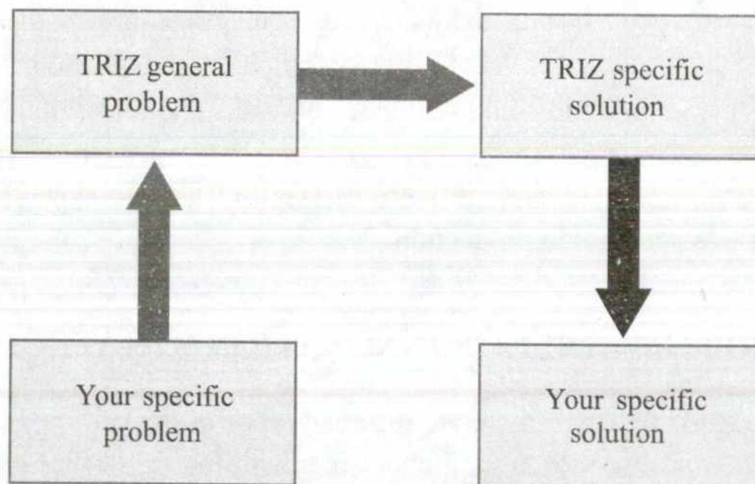


Fig. 3.4: TRIZ problem solving method

In the above figure the arrow represents transformation from one formulation of the problem or solution to another. The grey arrow represents the analysis of the problem and analytic use of the TRIZ databases. The black arrow represents thinking by analogy to develop the specific solution.

Here, you take the specific problem you face, and generalize it to one of the TRIZ general problems. From the TRIZ general problems, you identify the TRIZ solutions to those general problems, and then see how these can be applied to the specific problem you face.

Example

A powerful demonstration of this method was seen in the pharmaceutical industry. Following the flow of Fig 3.4, the specific problem was as follows: an important process needed cell walls to be broken down in bacteria cells so that hormones inside the cells could be harvested. A mechanical method for breaking the cell walls had been in use at a moderate scale for some time, but the yield was only 80%, and was variable. Higher yields and a scaleable solution were needed.

The TRIZ general problem at the highest level is to find a way to produce the product with no waste, at 100% yield, with no added complexity. One of the patterns of evolution of technology that TRIZ identifies is that energy (fields) replaces objects (mechanical devices). For example, consider using a laser instead of a scalpel for eye surgery. In this case, ultrasound could be used to break the cell walls, or an enzyme could be used to "eat" it (chemical energy). This may seem very general, but it led the pharmaceutical researchers to analyze all the resources available in the problem (the cells, the cell walls, the fluid they are in, the motion of the fluid, the processing facility, etc.) and to conclude that three possible solutions had a good potential for solving their problem:

The cell walls could be broken by sound waves (from the pattern of evolution of replacing mechanical means by fields).

NOTES

The cell walls could be broken by shearing, as they pass through the processing facility (using the resources of the existing system in a different way).

An enzyme in the fluid could "eat" the cell walls and release the contents at the desired time.

All three methods have been tested successfully. The least expensive, highest yield method was soon put in production.

3.13 CHRIS GRANNELL'S INNOVATION STRATEGIES

According to Chris Grannell there are different types of innovation, but there are also many different ways of talking about it – with the result that there is little consistency across academic texts on the subject. For instance, Clayton Christensen contrasts 'disruptive' with 'sustaining' innovation, while Gary Hamel talks about the distinction between 'breakthrough' and 'incremental' innovation. Other observers such as Geoffrey Moore prefer to think in terms of 'discontinuous' versus 'continuous' (or continuing) innovation, while other practitioners present another slant with other descriptions. For example, Phil McKinney (head of innovation at HP and author of the Killer Innovations podcast) chooses to focus on what he calls 'killer' innovation – useful because it captures the sense of a 'killer app': something which is both different and impactful to what is around it.

According to Chris Grannell there are three different types of innovation:

1. Incremental Innovation

Incremental or continuous innovation is typical of companies with Research and Development departments. It delivers gradual improvements like enhancing software, improving battery life, miniaturizing hardware or increasing brightness, and is a result of spending time on the systems, processes and technologies involved. It's about gradual evolution rather than a revolutionary step-change. Ultimately, it enables firms to keep up-to-date with the market and, ideally, to edge ahead. This notion has given rise to the term 'sustaining innovation', which may sound like a contradiction, but in fact acknowledges that the rest of the market is changing too. Firms like Sony have historically been very strong in this area.

2. Disruptive Innovation

Disruptive innovation is commonly associated with Harvard Professor Clayton Christensen. He uses the term 'disruptive' because it turns the conventional paradigm of the market on its head, not by improving on competitors' offerings, but by actually reducing functionality. If this sounds like a crazy idea, think about it for a moment. How many times from personal experience have we found ourselves faced with an incremental innovation that offered functionality that we couldn't actually use? The ability to store two million songs instead of one million, perhaps? Or take photographs

at eight-mega pixel resolution instead of three? Disruptive innovation challenges the commonly-accepted trajectory of rising functionality.

3. Discontinuous Innovation

Discontinuous innovation involves a radical seismic shift; a significant leap upwards in functionality. Products like Skype and iPod are in this category although they are frequently (and incorrectly) described as disruptive innovations because they have revolutionised their markets (or arguably even created new ones). But Skype and iPod are discontinuous rather than disruptive since they offer new features and benefits instead of cutting back on those of their predecessors.

3.14 ROLE OF MULTINATIONAL COMPANIES (MNC) IN RESEARCH AND DEVELOPMENT(R&D)

MNC's have a significant impact on global innovation and economy as they:

- Determine international division of labor with production, sourcing, Research and Development strategies
- Transfer technologies, capital and management capabilities
- Control a significant portion of privately owned technological resources
- Influence regional structuring
- Have high negotiation potential in view of their control on FDI

Internationalization started with search for additional markets, then for cheap factors of production, then for dominance of local markets and finally with fully developed R&D. Role of mergers and acquisitions was significant in this process. MNC's have a significant role for innovation in industry. Internationalization of sales and production sites, and R&D has increased.

R&D has a crucial role in building a company's global competitive advantage. MNC's have increased their investments in R&D in outside locations further through increase in Foreign direct Investment (FDI); they have increased their influence and ability to recover costs of R&D. FDI location choice is determined by location advantages while source of FDI indicates strengths of individual companies. FDI investments are still concentrated both in source and destination to Organization for Economic and Corporation Developments (OECD) countries and china.

3.15 MNCs IN US, EU AND JAPAN IN R&D TRIAD

R&D has always been considered a domain of firms in technologically advanced and economically developed countries. Indeed, the ten largest countries in terms of GDP also lead in terms of technology intensity (except for P.R. China and Brazil). Transnational companies account for substantial shares (between 33% to 57%,

according to a mid-1990s study reported in Gassmann and von Zedtwitz, 1999) of their total national R&D expenditures. Multinationals dominate private international R&D investments; of the 100 largest MNCs in the world (in the year 2000), 94 were headquartered in advanced countries, 3 in China, and one each in Mexico, Venezuela, and South Korea. Patent applications in the most important markets are led in numbers by large multinationals from the US, Japan, and Western Europe. Clearly, there is a dominance of domestic and international R&D by firms in advanced countries (Dunning, 1988; UNCTAD, 1999, 2001).

R&D in developing countries has figured less prominently. Most research has concentrated on technology transfer to these countries, and their capacity to absorb advanced technologies from abroad (e.g., Kim, 1980, 1997; Lall, 1990). Without a doubt, the level of science, technology, and innovation has been increasing over the last years, but the investment ratios of S&T to GDP are still far behind advanced countries (see Schaaper, 2004; OECD, 2002). Moreover, the leading multinationals from developing countries tend to be low on technology-intensity, and harvest natural resources such as real estate, oil & exploration, and mining & materials. R&D by the few technology firms in these countries tends to be comparatively weak: Lack of S&T resources and lack of local market demand for sophisticated and expensive technology goods discourage private efforts in serious R&D.

Figure 3.5 summarizes some of the previous research trajectories in international R&D research. The first type concerns "traditional" R&D internationalization among advanced countries, i.e. mostly within the triad countries of North America, Western Europe, and Japan. This area of R&D internationalization has been widely researched, and yielded a very valuable and rich literature as well as an fundamental albeit initial understanding of transnational innovation management. Most of the international R&D flows are covered by Type 1 research, as indicated by the preferred routes of foreign direct investment (the Triad countries accounted for 71% of all FDI inflows and 82% of all FDI outflows in 2001). However, the rise of China (and to some extend India) as a principal recipient and source of FDI in 2002 and 2003 has led to a new, "modern" category of research, denoted Type 2 in Fig 3.5. Examples of Type 2 R&D internationalization is IBM's establishment of R&D in India, Microsoft's Research lab in China, and Fujitsu's Development Center in Malaysia. This modern form of R&D internationalization became popular in the late 1990s, driven in part by improved economic conditions in South-East Asia, China, and Eastern Europe, in part by strategic considerations of parent companies to set global standards and build global brands, and in part by a growing understanding and financial commitment of Multinational Companies (MNCs) to support local sales with local Research and Development (R&D) efforts.

		Host Country: Developing	Host Country: Advanced
Home Country	Advanced	**Type 2** **MODERN** (e.g., US → China, EU → India)	**Type 1** **TRADITIONAL** (e.g., US → EU, JP → US)
	Developing	**Type 4** **EXPANSIONARY** (e.g., China → Brazil, India → China)	**Type 3** **CATCH-UP** (e.g., China → US, India → EU)

Fig. 3.5: Four phases or types of research on R&D internationalisation

Type 3 and 4 in Fig 3.5 denote a novel, so far mostly ignored direction of R&D internationalization. Arguably, researchers such as Lall (1987, 1990) and Kim (1980, 1997) have studied the acquisition and development of technological competencies in developing countries, but the notion of firms headquartered in developing countries establishing R&D capabilities outside their home countries is new. The espoused view was that firms in developing countries were too busy absorbing technology transferred from abroad, and hardly capable to push technological boundaries themselves. They would use their new competitive advantages to defend and build domestic market shares, and if they were sufficiently attractive enough, they would be acquired by much larger foreign multinationals. Some countries imposed policies protecting domestic technology companies, either by making foreign acquisitions more difficult or by curbing competition from MNC subsidiaries. In any case, the internationalization of business and technology has largely been unidirectional from advanced to developing countries.

Case Study: The Movie Rental Market

This project started in June of 2003 when the USPTO granted a broad patent to Netflix Inc., capturing the author's attention because GTI has patent circumvention methodology. While analyzing the situation, the author carried out evolution forecasting for the industry, which was updated in October of 2004 and became a part of a white paper in 2005. In December of 2004, the author was approached by a consultant for an entity that was going to buy the Hollywood Entertainment (HLYW) movie rental chain; his client became familiar with the forecast and got interested. This case study presents a certain portion of the old paper that was based on the original forecast (June 2003/October 2004), for which the author was not paid, so it is not a part of any agreement. The author periodically checked (the last time in December of 2007) how the forecast faired against the reality; comparisons between the forecast and real facts will be made.

The nature of a rental business is simple; customers want to use a product that they cannot or do not want to buy. Movies, which are often watched only

Check Your Progress

Fill in the Blanks:

4. Combination innovation is to combine .... together and get a new product.
5. According to Robert Camp definition bench marking .... that will lead to superior performances.
6. Transfer technologies, capital and management capabilities are the significant in part of the .... companies.

once, fit this requirement perfectly. In the fight for the customer's movie-viewing dollar, the rental business competes with movie theaters (only with new titles but at a greater expense for the customer) and pay-per-view cable programs (also with fewer, fresher and more expensive titles). Since the 1990s, the market has been dominated by Blockbuster Inc., the company that successfully wiped out most of its franchised and independent competition.

The typical movie-rental process involves numerous steps. Customers take a trip to the store, browses the shelves, finds what they like, check it out, return home, watch the movie, take another trip to the store to return the movie and return home again. There is a penalty if the movie is returned later than its due date.

The process is cumbersome, containing many redundant and no-value-adding steps such as multiple car rides, having to browse the available titles each trip and late fees. What this means is that there is definitely the opportunity for improvement in delivering a service of greater value to the customer. Netflix, Inc. was able to create a new business model that solved many problems associated with the original rental model.

The Netflix model has no due dates or late fees and no repetitive trips to the store. Movies are selected via the Internet and are then delivered and returned free of charge by mail (usually with a 24-hour turn around). To make the model financially viable, there is a subscription fee and restriction on a number of movies a customer can possess at any given time, but no restriction on the number of movies the customer can request in a month. As soon as a subscriber returns a movie, the next title from his saved selection list is immediately sent. This saved selection list keeps the customer from having to browse inventory every time a movie is requested.

The customer is clearly receiving greater value from the Netflix model, which is why Netflix was rewarded generously with 2.6 millions customers by the end of 2004, each paying about $20.00 per month as a subscription fee. Where did these customers come from?

Blockbuster tried to ignore Netflix for many years, but the bottom-line prevailed. In the summer of 2004, Blockbuster opened an Internet-based rental unit. By this time, however, Netflix had already established itself as the Internet-based market leader. As always happens with any successful innovation, the Netflix model's initial success immediately attracted a number of copycats. Not only did the existing players (such as Blockbuster) jump in, but also almost a dozen other companies joined the market, including Wal-Mart and Amazon.

Even at this early stage of development, the market became overcrowded with competitors that offered the same service for a similar fee. There was little clear differentiation between competitors. This led to service commoditization with subsequent price war, which only benefits the consumer. Since its inception in August, the price of Blockbuster's subscription has gone down from $21.00 to

NOTES

$14.99 a month. It can be easily foreseen that the entire market could be captured (and competition eliminated) by a diversified competitor such as Amazon or Wal-Mart, who would provide the rental service free of charge as an incentive to buy other products or services that offer more value to the provider that the cost of the monthly service charge. Since people already buy products online from Amazon, such an incentive would be a logical and attractive proposition for both provider and customer.

What does the future hold for the movie rental industry? The Netflix model has a time delay between placement of an order and movie delivery (about one day). Based on the principle of time-to-value reduction, it can be predicted that movies will be delivered to a customer's screen (via cable, Internet, satellite, etc.) at the moment they are requested; for the cost that she pays now for a movie rental, the Netflix model will become obsolete. At that time, all of the companies that have adopted the Netflix model will have to accept the new model, switch to a different market or go out of business.

Some might say that this was too obvious, too easy. But this simplicity is exactly why understanding of the predictable nature observable in the evolution of any product or service is such a valuable planning tool. Indeed, the concept of movies on-demand has been around for a number of years. Moreover, there are companies that already provide this service over the Internet. Certain technical challenges (such as minimization of download time and movie quality) still need to be addressed to make this model a viable reality, but it can be predicted that this will happen in the not too distant future.

The emergence and evolution of the movie-on-demand service raises additional problems, but in the application of GTI this is equated with more business opportunities. For example:

- Since the Internet has a limited capacity and is often overloaded, what alternative methods are there for downloading movies? The answer leads in the direction of cable, satellite and wireless communication, and also clearly indicates who the future competitors will be. Major telecoms, including cable and satellite television service providers, telephone companies and ISPs all have the resources necessary for providing this service and can be expected to join the competition.
- Stationary TV sets and computers will not be the only devices used to download and view movies cell phones, PDAs, portable DVD players and even smart watches can be used. For this to work, these devices may need to periodically plug in and update their memory. This, in turn, will require a greater convergence of PDAs, cell phones and portable DVD players with computers, producing another new opportunity in this market. (Update: Verizon Wireless introduced movie on demand download to its customer base in 2005.)

NOTES

- A great business opportunity is associated with providing movies on-demand to travelers. This is especially attractive in that you have a large, captive audience looking to add value to their under utilized travel time (again, the principle of time reduction is applied). The car market is especially big and, therefore, tempting. Related but somewhat different from this travelers' market are people waiting in restaurants, hospitals and hotels. Here a customer base of organizations instead of individuals can be developed.

Will these inevitable developments in the movie on-demand industry completely replace the traditional retail rental industry? No, it is an unlikely development. The market for traditional rental service will survive as a niche, but in a modified and shrunk form. It will be defined by circumstances where download service is impossible, inconvenient, prohibited, etc.

For example, if downloaded movies are prohibited during flights due to safety concerns, a new business opportunity emerges. A network of retail rental kiosks located in airports could rent movies, DVD players or both to customers about to board a plane, and returns would be made at the destination point. This service could also be ordered through an airline while booking a flight, with movies delivered directly to your seat after boarding. (Update: In 2004, one billion people worldwide flew. If only 10 percent of them (i.e., 100 million) had given an innovative entity $10.00 per rental event, it would have added one billion dollars to the bottom line.)

Another similar opportunity would be to provide a service for people who forget to download movies prior to their car trips. They could stop by a store and rent a movie, DVD player or both. However, this market will be small. Therefore, stand-alone rental stores will again give way to the travelers' kiosk, this time in gas stations and convenience stores such as 7/11. Perhaps this type of rental will include DVD with timed, self-destruct mechanism so that returns are not an issue.

Another opportunity can be again identified by using the time-to-value reduction principle. If today's business model requires a dedicated trip to a store, then bringing movies to the locations where people (customers) will be represents an interesting opportunity. For example, locating rental stores at malls, supermarkets or office buildings would provide a major value for the customers. Imagine positioning a few stores at a large technical center where tens of thousands of people work and delivering movies to their desks by the end of a working day.

In the meantime, due to the strength and direction of the competition for retail customers in the market, Blockbuster dropped its late fees; this is probably too little too late. Emergence of the on-demand movie model, along with excessive competition and service commoditization in the Internet-based niche, have created a situation in which the entire industry stands on the brink of major change and

the outcome for any particular competitor is unclear. The financial markets seem to be in agreement with this conclusion. While the general market trend rose in 2004, the movie rental industry was depressed, as shown in Fig. 3.6 of course, the investment community does not like uncertainty, and it is uncertain whether future developments in the movie rental market will become opportunities or threats for the current competitors. This solely depends on the strategic decisions made by the leadership of each company.

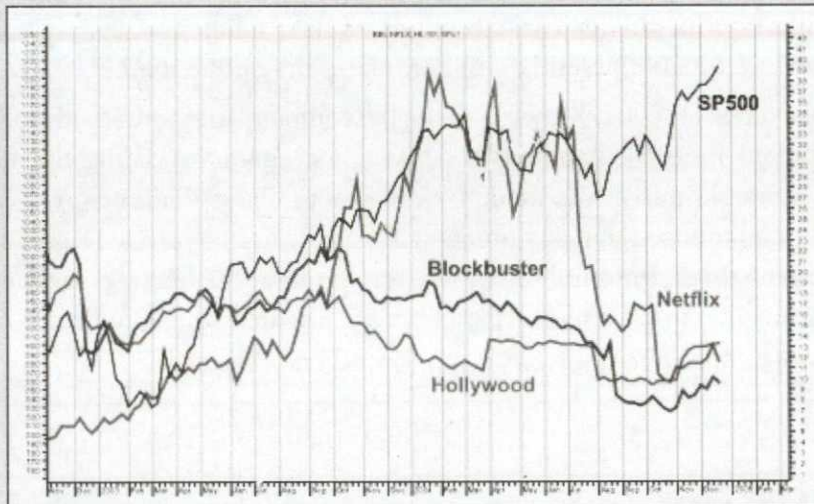


Fig. 3.6: Market punished by movie rental companies in 2004

All of the above clearly indicates that for any traditional rental company gaining advantage lies through significant change, requiring capital expenditures leading to a change in valuation. If such a company continues its business as usual, it is surely poised to continue sliding and losing to savvier rivals until the change prescribed by the law of an increasing degree of freedom is introduced; the sooner it happens, the better and more advantageous it will be for this entity.

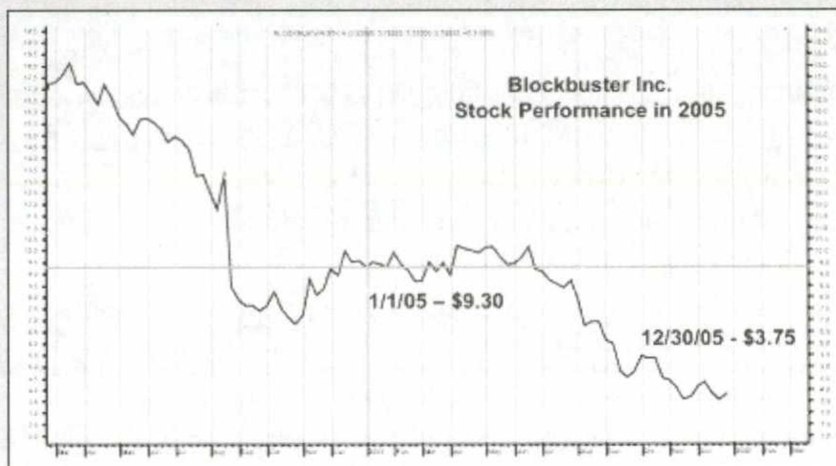


Fig. 3.7: 2005 Performance of blockbuster Inc. stock

Update: The forecast played well with the client who decided to pass on the opportunity. The chart in Fig 3.7 illustrates what happened to Blockbuster, the company that did not change and stuck to the old business model in 2005. Its stock dropped from $9.30 to $3.75, a huge loss for investors. This slump continued until the summer of 2007 when the company CEO's, John Antioco, was replaced. His successor, James Keyes, quickly realized the need for a change. Blockbuster entered the movie download-on-demand niche by purchasing Movielink LLC. The same move made earlier in 2007 by Netflix complying with the forecast. Meanwhile, Netflix truly enjoyed its online pioneer status. By 2007, its customer base grew to 6,613,000; Netflix still dominates the online market.

On october 11, 2007, Movie Gallery, the company that purchased Hollywood Entertainment in 2004, announced bankruptcy, again validating the forecast. The last strategic move was made by drug store chain Walgreen. On October 28, 2007, it announced that customers will be able to buy movie DVDs that will be burned in stores. Entering the movie rental market is the next logical move, which means that brick-and-mortar stores are threatened, as predicted.

Source: *http://www.triz-journal.com/archives/2008/04/06/*

3.16 SUMMARY

- The behavioral perspective claims that decision makers use an aspiration level to evaluate firm performance, and that the gap between their own performance and the aspiration level influences their behavior toward search and risk taking.
- Open innovation principles describe how to deal best with strategic assets in order to meet market demands and company requirements.
- The concept of dominant design was central to Abernathy and Utterback's (1978) model of industry evolution based on a shift from product to process innovation.
- In the innovation management field the S-Curve illustrates the introduction, growth and maturation of innovations as well as the technological cycles that most industries experience.
- Brainstorming is one of the most popular techniques used to induce creativity and so deserves special mention.
- Combination innovation is to combine more than two technology elements together and get a new product. Those technology elements are usually substance unit, techniques, principles, structures, functions and so on.
- Breakthrough innovations are generally considered "out-of-the-blue" solutions that cannot be compared to any existing practices or techniques. These innovations employ new technologies and create new markets.

- Complexity is defined as the measure of heterogeneity or diversity in internal and environmental factors such as departments, customers, suppliers, socio-politics and technology.
- According to Chris Grannell there are three different types of innovation including incremental innovation, disruptive innovation and discontinuous innovation.
- R&D has a crucial role in building a company's global competitive advantage. MNC's have increased their investments in R&D in outside locations further through increase in FDI.

3.17 KEY TERMS

- **Open innovation:** Open innovation means that the company needs to open up its solid boundaries to let valuable knowledge flow in from the outside in order to create opportunities for co-operative innovation processes with partners, customers and/or suppliers.
- **Brainstorming:** Brainstorming is one of the most popular techniques used to induce creativity and so deserves special mention.
- **Combination innovation:** Combination innovation is to combine more than two technology elements together and get a new product.
- **Breakthrough innovations:** Breakthrough innovations are generally considered "out-of-the-blue" solutions that cannot be compared to any existing practices or techniques.

3.18 ANSWERS TO 'CHECK YOUR PROGRESS'

1. strategic flexibility
2. S-Curve
3. dominant design
4. more than two technology elements
5. as the search for the best practices
6. multinational.

3.19 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the Ed DeBono's six thinking hat?
2. Define breakthrough innovation.

3. What are the different types of combination innovations?
4. Discuss the role of MNCs in R&D.

Long-Answer Questions

1. Write a note behavioral theory of R&D investment and innovation.
2. State the difference between the open and closed innovation approach.
3. Write a note on technology S-curve theory.
4. Write a note on the following theories of innovation:
   - ❖ Benchmarking
   - ❖ Complexity theory
   - ❖ TRIZ/TRIP theory
5. Write a note on MNC in US, EU and Japan in R&D Triad.

UNIT 4 INNOVATING FIRMS

NOTES

Structure

4.0 INTRODUCTION

Innovation is the process by which organisations use their resources and competence to develop new or improved goods and services or to develop new production and operating systems so that they can better respond to the needs of their customers. Innovation can result in spectacular success for an organisation. Apple computer changed the face of the computer industry when it introduced its personal computer; Honda changed the face of the small motor-bike market when it introduced small 50 cc motor cycles; Mary Kay cosmetics changed the nature, the way cosmetics were sold when it introduced its at-home cosmetics parties and personalized style of selling; Toyota revolutionised car production system to increase product quality; and Chrysler's adoption of a new operating system, the product-team structure, was an innovation that many other companies have copied.

Although innovation brings about change, it is also associated with a high level of risk because the outcomes of research and development activities are often uncertain. It is estimated that only 12 to 20% of Research and Development (R&D) projects result in products that get to the market. Sometimes companies bring in new products through innovation by destroying their own existing products before someone else does.

4.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Explain innovative features of the selected top innovators of the world.
- Discuss organisational climate for creativity and innovation.

4.2 INNOVATIVE FEATURES OF THE SELECTED TOP INNOVATORS OF THE WORLD

NOTES

The given below are the innovative features of top innovators of the world:

1. Facebook

Facebook, which is just turning six, has achieved a level of maturity most wags thought would never come. Somewhere along the road to becoming the platform of choice for 400 million users in every country on earth, the company grew up. A Facebook Page is a customisable presence for an organization, product, or public personality to join the conversation with Facebook users. The Page focuses on the stream of content posted by the Page administrators.

By leveraging the real connections between friends on Facebook, a Page lets Fans become brand advocates. Posts by the Page will start to appear in News Feed, giving Pages a stronger voice to reach their Fans. The following are the recent innovative features of a facebook page:

- **Enhanced Wall:** The Page's Wall tab will enjoy the same rich, multi-media functionality as the Wall tab on a user Profile. The Wall is a central location for recent information posted by you and about you. It's where you keep your up-to-date content, and where Fans can contribute.
- **Update and share:** Like a user profile, your Page can now update its Fans with statuses—short text-only messages. These statuses will appear in Fans' News Feeds.
- **Tabbed Structure:** The tabbed structure multiplies your possibilities. Similar to their functionality in user Profiles, tabs help keep Pages organized so people know where to go to get different pieces of information. The Wall tab is for dynamic content, the Info tab has static information, the Photos tab contains photos albums and Fan photos, etc.
- **Measuring Engagement and Interaction:** The Facebook Pages Insights tool will include new data on Fans' engagement with posts from your Page. You'll be able to see how many comments Fans make on your posts, and you'll also be able to track how many Facebook users start and stop viewing your posts in News Feed.
- **Wall:** The Wall tab closely resembles the Wall tab on a user profile. You and your Fans can use the turnkey publisher tool in the main column to share comments and even rich media. Posts by your Page go to your Fans' News Feeds, and comments by your Fans go to their friends' News Feeds. Those posts will hyperlink back to your Page.

2. Amazon

Amazon.com Inc., a Fortune 500 company, incorporated in 1994 / Washington and reincorporated in 1996 / Delaware, went online on the World Wide Web (WWW)

in July 1995. Since its IPO in May 1997, Amazon is listed on the Nasdaq National Market. The company's stated strategy is to "focus on customer experience by offering [their] customers low prices, convenience, and a wide selection of merchandise." Started as a pure online book retailer, Amazon.com began expanding its product and service offering. New business models were introduced in 1999, web hosting and fulfilment service partnerships with traditional retailers and consumer portals followed in 2000.

When Amazon went online, the book industry was highly fragmented with the largest retailer Barnes & Noble (B&N) only representing 11% of total book sales in the US. B&N operated its stores as superstores (covering 6000m^2 and stocking up to 175,000 titles) and mall-based stores (smaller in size and selection), but also offered mail-ordering through catalogue services.

B&N had a centralized logistics and distribution centre and could thus leverage scale economies in procurement by sourcing books directly from publishers, obtaining higher discounts than other book retailers, and avoiding high mark-ups from wholesalers. Due to centralized stock, books could be shipped to the points of sale within a few days, avoiding delivery delays from publishers. B&N installed an electronic store (management) system, enabling real time information exchange among its stores, the distribution centre and wholesalers with access to a 2.5M title database, though not accessible for customers.

Amazon redefined traditional book retailing through a radically different approach: online, over the Internet. Traditional book retailing has several drawbacks. The selection of titles is physically limited by available store space. Traditional retailers must invest in inventory, real estate and qualified personnel for each retail location and it is impossible to provide "a customized store for every customer or to provide customized recommendations without significantly increasing selling costs." Internet retailers have the advantages of centralized inventory management and low occupancy costs. A large and global group of customers can be reached from a single central location, making the business model very scalable. It is possible to track consumer purchasing patterns in order to better anticipate demand and to provide personalized services such as customized store fronts.

Amazon's business model combined informational elements (virtual storefront) with physical elements (operations). While Amazon highly invested in information technology, with a strong focus on software rather than hardware, its operations were practically limited to packing and shipping at that time.

3. Apple

Apple is a visionary organization that has a clear vision and purpose that can be seen through their innovative products over the years. Apple's original vision was, "to make computers for the rest of us," while their purpose is, "to make a contribution to the world by making tools for the mind that advance humankind"

During Apples thirty years of existence, Steve Jobs has established several changes because of competitive opportunities. In the 1980s Macintosh development era. Jobs created a race to market. The Lisa team had started work on their product years before the Macintosh team had started their project. Steve Jobs made a bet that his team which featured the Macintosh would be the first to market. Unfortunately, Jobs lost the bet: the Lisa did launch before the Macintosh. However, Jobs was the true winner because the Macintosh won the longer race in the market place.

One of Apple's significant achievements has been "the implementation of the office workplace of tomorrow". Apple "inaugurated the workplace of the future by putting computers on most of its employee's desks". Mike Scott, Apple president at the time said, "Apple is an innovative company. We must believe and lead in all areas. If word processing is so neat then let's all use it. We believe the typewriter is obsolete. Let's prove it inside before we try and convince our customers". This internal move increased employees effectiveness, improved job satisfaction, and led to very little turnover. It freed managers from doing mundane and time consuming paperwork tasks. This newly available time allowed them to coach employees leading to a much improve workplace atmosphere.

Apple's ability to change paradigms as an industry leader is obvious in the history of the short lived personal computer industry. Apple created the personal computer industry; then they innovated the Graphical User Interface (GUI). Adopted by the industry the GUI, innovated the desktop and file folder metaphor that has predominated the industry. Apple is now innovating appliance [model in computing products that integrate vertically from device to network to content. The iPod and iPhone product lines are examples of Apple's ability to envision a paradigm change, put that vision into action and achieve game changing results. Kotter's seventh step is evidenced by "using increased credibility to change systems, structures, and policies that don't fit the vision". Apple has used its very successful music industry changing iPod product line with iTunes music store credibility to also change the smart phone application market, achieving 1.5 billion downloads in the first year of Store operation (Elmer-DeWitt. 2009). Apple has used the "core competencies that the company has acquired over its thirty year history, notably in product marketing and innovation" to redefine market segments. On the success of the iPod and iTunes music store. Apple launched its IPhone, creating the most successful convergence device. The iPhone has proven that Apple can both consolidate their core competencies while continuing to innovate.

4. Google

Google has triumphed through innovation. When it was launched in 1998, it quickly became the search tool of choice for the professional researchers due to the superior relevance of its results coupled with its ease of use and large index of websites. Since that time, its popularity has grown dramatically with over 250 million searches now performed on Google everyday world wide, making it one of the best known

brands in the online world. Google uses sophisticated next-generation technology to produce the right results fast with every query. Google returns relevant results because it responds to your query using an automated method that ranks relevant websites based on the link structure of the Internet itself. Marissa Mayer works as the director of consumer web products at Google and has spearheaded almost every user-interface change to the Google web site for the past four years. She also teaches computer programming at Stanford.

Google is taking some specific steps to encourage innovations, which are crucial for Google to be able to compete with giants like Microsoft and Yahoo! as well as newcomers like Technorati.

- **Rigor and discipline:** Google mentions that not only creativity is the key to their success, but so are the rigor and discipline behind their approach. The company has eight brainstorming sessions each year with 100 engineers. Six concepts are pitched and discussed for ten minutes each. The stated goal is to build on the initial idea with at least one complementary idea per minute.
- **Lead from the top:** Google recognises that it is not enough to allow anyone at the firm to post thoughts for new technologies and businesses to mailing lists. They have instituted supporting processes that are led by management. Marissa Mayer, the Director of Web Products at Google, has open office hours much like a college professor where employees can talk through ideas. Google's personalised home page came out of this process. Also, all engineers have one day a week to develop their own pet projects, no matter how far from the company's central mission. Google News came out of this process.
- **Act like a venture capitalist:** Google is willing to look for great ideas not only inside the company but outside as well. In 2004, the company bought Keyhole, which allowed them to develop Google Maps with sophisticated satellite imagery and maps.

Google Inc. (Google) is a global technology company focused on improving the ways people connect with information. The Company generates revenue primarily by delivering online advertising. As of December 31, 2011, the Company's business was focused on areas, such as search, advertising, operating systems and platforms, and enterprise. Businesses use its AdWords program to promote their products and services with targeted advertising. In addition, the third parties that comprise the Google Network use its AdSense program to deliver relevant advertisements that generate revenue. In June 2011, the Company launched Google+, a way to share online. As of January 2012, over 90 million people had joined Google+. In April 2011, the Company acquired PushLife. In September 2011, the Company acquired Zagat.

5. Novartis

Since focusing its R&D on rare diseases and biotech, including vaccines for the likes of H1N1, the Swiss pharma giant has been in a fever of invention. The FDA has

approved nine of its drug candidates in 2009 alone. Long development cycles, huge R&D investments, and a high chance of failure makes the pharmaceutical industry risky business. For Novartis Vaccines & Diagnostics, which develops preventive vaccine and diagnostic tools, it's crucial to effectively manage its R&D pipeline and vaccine investment decisions.

In order to be competitive, Novartis sets strategic objectives for the timing and number of its commercial product launches. Having the right portfolio of vaccine development projects across the various stages of its R&D pipeline is key to achieving these objectives. If the project portfolio becomes unbalanced, it must be rebalanced by investing in new vaccine development projects.

To improve its portfolio management process, Novartis first required better forecasts of how vaccine development projects might move through its R&D pipeline. Then, using these pipeline performance forecasts, Novartis sought to optimize its acquisitions of new vaccines to augment its existing R&D project portfolio. Finally, Novartis needed to understand how its portfolio management decisions translated into financial performance.

6. Walmart

Walmart's core competence can be said to be its knowledge achieved by its inventory management skills with its supply chain management facilitated by its innovations like the cross-docking techniques and its innovation in information technology and in relationship strategy maintained with its customers, suppliers, and associates and its cost strategy achieved with its scale of operations. Wal-Mart's internal architecture with its associates are phenomenal and the way it manages its one million plus associates. Wal-Mart's collegiate culture encourages innovation and learning.

Externally Wal-Mart enjoys a unique relationship with its suppliers who go to the extent of locating their offices near Wal-Mart's headquarters. Wal-Mart has a reputation for innovation with the formats of stores introduced and its ability to replicate with adaptations to suit local markets. Innovations in technology by using VSAT light years ahead of its times and its warehousing and cross-docking techniques are laudable.

The following are the highlights of key innovation introduced by Wal-mart:

- **Packaging:** In 2005 Walmart introduce super concentrated liquid laundry soap in partnership with Unilever. The move remakes the industry, saving an estimated 25 million pounds of plastic resin, 140 million gallons of water, and 40 million pounds of cardboard each year.
- **Greener Light bulbs:** In 2006 the company introduced the CFLs for saving energy. Despite the higher price tag, it sells 137 million CFLs, which use 75% less energy than incandescents.

- **Alternative Energy:** In 2007 Walmart launches a solar-power pilot, installing solar arrays on top of 20 stores in California, eliminating 6,000 to 8,000 metric tons of greenhouse-gas emissions each year. In April 2009, Walmart expands its partnership with BP Solar to 20 more locations, providing 20% to 30% of their total electricity needs.
- **Store Design:** In 2007 the company builds its first high-efficiency pilot store in Kansas City, Missouri. The sixth iteration of the store design, in Sacramento, is 30% more efficient than traditional super centers, thanks to daylight-harvesting systems, LED-lit display cases, evaporative-cooling and radiant-flooring technologies, and detailed energy-management systems.
- **Reusable Bags:** In 2008 the company commits to reduce its global plastic shopping-bag waste by 33% over five years (that's 9 billion bags). The next month, it introduces a 50-cent reusable shopping bag in U.S. stores. By the end of the first year, it had used 2.5 billion fewer bags.
- **Supply Chain:** In 2009 Walmart announces its sustainability initiative to track the life cycle of every product it sells, measuring it on water use, greenhouse-gas emissions, and fair labor practices. Walmart is now hosting industry-by-industry meetings to debate what this consumer label will look like.

7. HP

Hewlett Packard (HP) is an example of an organisation which has been able to successfully communicate the importance of innovation, and create an environment in which employees feel encouraged and empowered to generate ideas and take them forward. HP hosted a series of "Power-Up" events which were a chance for the company to showcase its recently developed cutting edge ideas and projects, across the entire organisation. This demonstrated the importance of ideas and innovation, and management has been trained to foster innovation by not overly interfering with engineers and technical staff, but instead they allow their staff to develop ideas, and the role of the manager is to try to ensure the outputs and ideas generated by the employees can be commercialised (Braganza, 2009).

8. Nike

Nike is a US$19 billion company with brand recognition that ranks up with Coca-Cola, Apple, and Cadbury. With a global following and global demand comes enormous responsibility. The company operates and leads within an industry where performance rules, so sustainability intuitively is not a fit. Nevertheless Nike and its VP of Sustainable Business and Innovation, Hannah Jones, are turning the idea of how to approach sustainability on its head. And with such a strategy, Nike rethinks design, innovation, and progress. To that end, Jones set the tone of GreenBiz's Innovation Forum this week in San Francisco.

Like many companies, Nike faces a future of constrained resources and rising prices. "Sustainability" to most companies' means creating a product that is "less bad" or "better," but Nike decided to learn how its employees could view

NOTES

sustainability through a design lens. Balancing those goals while focusing on Nike's core capabilities, the road to high-performance yet more sustainable products was bumpy. The results, however, have transformed a company's culture and purpose.

The upshot is that Nike has integrated sustainability and innovation processes throughout the organization. Sustainability professionals have to think about the company's systems, while employees are encouraged to view innovation through the lens of sustainability. And "innovation" applies at all levels of the company: in its products, processes, revenue generation, business model, and throughout its industry. Furthermore, while companies traditionally kept their research and development work locked and hidden, Nike took the approach of Linux and Napster and decided to take an open sourced approach towards sustainability.

9. Intel

The platform leadership strategy of Intel contained three major rules—sponsoring innovations in PC architecture, stimulating external innovations on complements, and finally, coordinating industrial innovation. While the PCI bus designed by Intel helped in creating a better PC system architecture, the AGP was a step further in developing a fast interface that transferred data between the microprocessor and various graphic cards.

Even with these, various blockages like the limited bandwidth between PCs and peripherals like scanners, printers and digital cameras, which ultimately slowed down the overall performance, could not be removed. Thus, Intel decided to go for another innovation called the Universal Serial Bus (USB) in the mid-1990s. The USB was a new interface linking the PC to external devices such as the keyboard, scanner and the printer. It was a 'universal' plug in the PC wherein several peripherals could be connected into one USB plug. Here again Intel faced the same problem, that of PC architecture, because manufacturers like the IBM and others designed their PCs in a way that each peripheral device needed its own individual plug at the back of the PC. In order to make the USB successful, Intel need to convince PC manufacturers to build USB compatible systems.

Intel handled this challenge by attempting to stimulate innovation on products that could connect to this interface (USB) and acted on Lever 3 by creating business possibilities for external companies. As a result, many companies became complementors of the PC platform by adopting to the new USB interface. Before March 1996, Intel was able to integrate the necessary logic into the PC chip sets and also encouraged other manufacturers to do likewise.

Intel had the desire to act as a catalyst in the industry innovation. For this, it devised a two-way strategy: One was to stimulate complementary innovations, which would enhance the PC, and the second, to define the parameters of compatibility among complementary products made at other firms. The second dimension involved playing a coordinating role to stimulate innovation in other firms. These strategies

were implemented with the help of IAL, which helped Intel to raise the barriers to entry for any firm that wanted to compete directly with the Intel-sponsored (and industry-backed) PC architecture. Intel adopted the following strategies to maintain a sophisticated approach to manage external relationships:

- Building momentum around interfaces
- Relinquishing royalties on intellectual property
- Using public to generate momentum and also to refine standards
- Organizing compliance workshops called the 'plug fests'
- Creating and distributing enabling tools
- Strong marketing campaigns to enhance its brand image.

10. IBM

IBM consistently features as one of the world's most innovative companies on most learned lists and as such, its business research cannot be taken lightly. Before the recession it highlighted "creative beyond customer imagination" as the key feature of the enterprise of the future.

11. GE

For the past several years, General Electric has been undertaking a thoroughgoing effort to improve its innovation performance that is emphatically driven from the top. Beth Comstock, GE's first-ever Chief Marketing Officer, is leading the drive, while Jeff Immelt, GE's CEO, has budgeted a considerable portion of his time to pushing GE's innovation initiatives.

The following are the key innovation in GE:

- **Engineering a Service Solution:** Manny Mannava of GE Aircraft Engines readies a fan blade for laser shock peening, a new GE process aimed at increasing the durability of aircraft engine components. Enhanced durability translates into more time between scheduled inspections and off wing service, reducing maintenance costs for GE customers.
- **Developing a Better Silicone:** Judy Serth-Guzzo, a chemist at the Research and Development Center in Schenectady, New York, led a Six Sigma project that resulted in a new low-cost, high-performance, heat-cured elastomer. This new silicone rubber being developed for medical tubing and automotive gaskets, was designed to meet customer requirements for hardness and ductility.
- **Imaging Patients with LightSpeed:** Diane Radowski assembles a LightSpeed Matrix Detector, developed by a GE Medical Systems team using Six Sigma tools. The detector, which has 14,592 individual elements, makes multi-slice scanning a reality, allowing the new LightSpeed CT scanner to deliver faster, more detailed images of the human body than ever before possible.

12. Disney

Disney has leveraged competencies and strategic assets as well as any other

company in the world. Following the success of its brand in three-dimensional (3D) entertainment, it realized it had exceptional skills in set design, costumes, story-telling and performance arts. It thought about where else these skills could be adapted, and decided to branch out into live theatre production. Beauty and the Beast and The Lion King are now amongst the most successful live musicals in the world, playing Broadway, London's West End and many other places. This embodies systematic thinking about capabilities and their exploitation, in creating and meeting new market needs and opportunities.

13. Cricket

Cricket is said to be deeply rooted in tradition and considered to be a gentleman's game. The game has undergone much transformation because of the innovation being implied into it. Innovation has touched the game in every field-the way game is played (20-20, ODI, Test), shape and size of bats, innovative batting and bowling techniques (the class of some individual genius like paddle sweep of Sachin Tendulkar, doosra of Saqlin Mustaq, Marillier shot of Douglas Marillier and so on) and so on.

As innovative minds put their heads into the game, technology became an important division of the game. Different technologies are being used today in cricket to ensure fair play and maximum entertainment. Snickometer is one of such technologies.

Snickometer is one tool which is being primarily used to check if the ball had any contact with bat. It was introduced by Channel 4 of UK in 1995. It is used by commentators to evaluate the validity of field umpire's decision. Further, this kind of action reply technology is of commercial importance for broadcasting companies as it greatly enhances the viewer's entertainment and interest in the cricket match.

14. Indian Premier League (IPL) 20-20

IPL or the Indian Premier League is the new innovation in the field of sports. It has been the major upheaval to the game of cricket, which no one has ever witnessed. In a country like India, cricket is worshiped like a religion. This is the shortest game format until now, which has been reduced from the earlier format of test matches to one dyers and finally to the 20 over game, so better for its power packed entertainment, energy and excitement. This is a situation when Indians will be praying for their extreme rivals, a great way to unite the entire world.

15. Samsung

To put the principles of Open Innovation into operation, Samsung adopts a multi-pronged approach that involves participation in global consortia, forging links between the industry and top universities, cooperation with vendors, and operation of successful overseas research centers. Samsung is committed to producing best-in-class research in the materials and technologies of tomorrow. To foster a culture of ongoing, results-oriented innovation, the organization provides attractive remuneration for research activities.

NOTES

Samsung has set up multiple research centers in various countries. These overseas R&D hubs perform valuable research in emerging materials and technologies in the spheres of hardware, software, and packaging. The centers also help Samsung establish a credible market and mindshare presence in their respective countries. With the help of the overseas centers and their research excellence, Samsung is able to increase the volume of R&D operations, concentrate researching application-specific technologies, and finally, put the results of the overseas research projects to practical use.

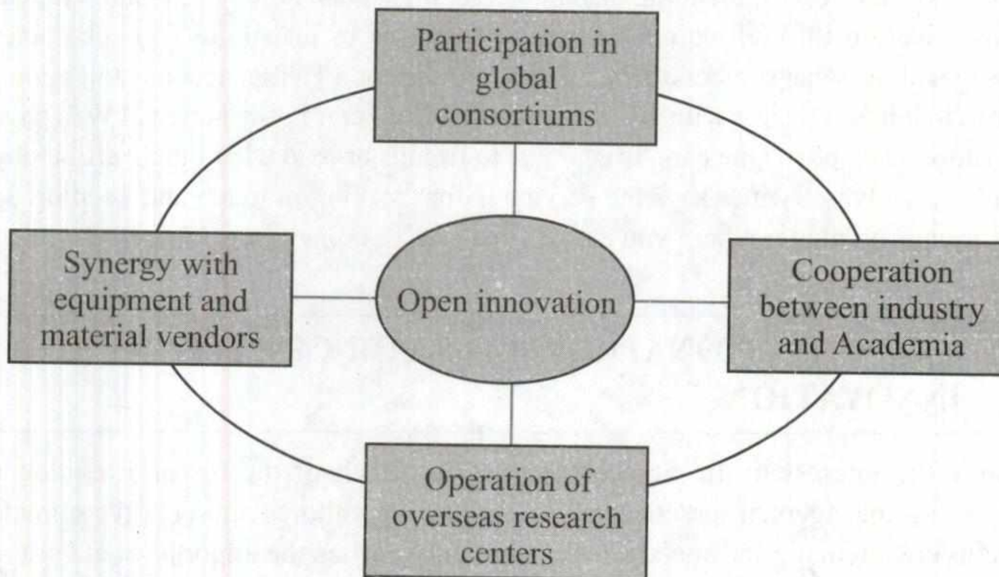


Fig. 4.1

16. Microsoft

Ever since its inception, Microsoft has been dominating the software side of the PC platform with its MS-DOS and Windows operating systems. Microsoft was well aware of the fact that Windows would be of no use and would not generate sales without any additional applications. This was where its strategy of `platform leadership' differed from that of Intel. Microsoft's strategy was to rely on making its own complements—thus the development of applications like Word, Excel, Outlook, e-mail, scheduler and even an information manager embedded in Windows.

The scale and importance of the complements of Microsoft differentiated it from Intel, which made relatively a small number of complements to its microprocessor. On the other hand, there were a few similarities as well. Like Intel, Microsoft dominated a significant part of the PC platform, worked hard to evolve its operating systems and shared a part of its proprietary technology openly with potential complementors (external). Microsoft always believed in building its operating systems incrementally, (from Windows 3 to Windows XP) offering multiple versions of the software platform gradually for individuals, groups and corporate customers. The company actively promoted standards that would be beneficial to it as a platform leader; first the standards in DOS and again in Windows.

Check Your Progress

Fill in the Blanks:

1. .... is a customizable presence for an organization, product, or public personality to jounthe conversation with Facebook users.
2. As of January 2012, over .... million people had joined Google+.
3. .... has reputation for innvoation with the formats of stores introduced and its ability to replicate with adaptations to suit local markets.

To face the challenge posed by the Internet, Microsoft packed a browser with Windows and pursued deals aggressively with PC manufacturers to make Internet Explorer as their default browser. To face the threat posed by competitors, Microsoft restructured its Windows software platform, server products, applications and MSN in a manner that made Internet browsing facilities available as 'Windows services', made available to Windows users by accessing the Microsoft.NET features.

17. Twitter

Twitter is a free service blending instant messaging, social networking and wireless communication through computer and cell phones to distribute 140- character messages about what someone is doing. A person opens a Twitter account and invites friends to join or connect with other members. A Twitterer gets a personal Web page that shows each post. One can "tweet" just to friends or read what others are saying about themselves. Twitter says the service is for "staying in touch and keeping up with friends no matter where you are or what you're doing."

4.3 ORGANISATIONAL CLIMATE FOR CREATIVITY AND INNOVATION

Despite the interest in the field of innovation, much of the research evidence concerning management practices about innovation cultures and creative climate remains unsystematic and anecdotal. As mentioned earlier, the importance of culture has been emphasized by organizational theorists such as Burns and Stalker (1961), who present a case for organic structures as opposed to mechanistic structures. In popular literature, Peters and Waterman (1982), similarly present arguments, which suggest that in order to facilitate innovation, work environments must be simultaneously tight and loose. Burlgeman and Sayles (1986) highlight the dependency of innovation with the development and maintenance of an appropriate context within which innovation can occur. Judge et al. (1997) in presenting findings from a study of Research and Development (R&D) units compare cultures and climates between innovative and less-innovative firms and argue that the key distinguishing factor between innovative and less innovative firms is the ability of management to create a sense of community in the workplace. Highly innovative companies behave as focused communities whereas less innovative companies units behave more like traditional bureaucratic departments.

The following are the key managerial practices that influence the organizational innovation:

4.3.1 Autonomy and Entrepreneurship

Autonomy is defined as having control over means as well as the ends of one's work. This concept appears to be one of central importance. There are two types of autonomy:

- Strategic Autonomy: the freedom to set one's own agenda;
- Operational Autonomy: the freedom to attack a problem, once it has been set by the organization, in ways that are determined by the individual self.

Operational autonomy encourages a sense of the individual and promotes entrepreneurial spirit, whereas strategic autonomy is more to do with the level of alignment with organizational goals. It appears that firms that are most innovative emphasize operational autonomy but retain strategic autonomy for top management. Top management appears to specify ultimate goals to be attained but thereafter provide freedom to allow individuals to be creative in the ways they achieve goals. Giving strategic autonomy, in the sense of allowing individuals a large degree of freedom to determine their destiny, ultimately leads to less innovation. The results of strategic autonomy are an absence of guidelines and focus in effort. In contrast, having too little operational autonomy also has the effect of creating imbalance. Here the roadmaps become too rigidly specified, and control drives out innovative flair, leading eventually to bureaucratic atmospheres. What works best is a balance between operational and strategic autonomy.

4.3.2 Close to the Customer

The origin of creativity and innovation lies in a shared vision and mission, which are focused on the future. Furthermore, the vision and mission of a creative and innovative organization are also customer and market oriented- focusing on solving customers' problems among other things. An example of a vision that emphasizes creative and innovative behaviour is: "Our company will innovate endlessly to create new and valuable products and services and to improve our methods of producing them" (Lock and Kirkpatrick, 1995).

Innovation is first seen as a way to create new forms of value for customers, in addition to internal cost and efficiency related innovation. These companies and their executives and staff know that the key to innovation is value creation for customers, in the sense that all innovation efforts must be aimed at creating superior customer value. This can be in the form of new or improved products and services, or process innovations that reduce cost and therefore allow for more competitive pricing while achieving solid margins. But, with whatever else is going on, it is always about the customer! And not only is it about the superior outcome for the customer, but also often with the customer as part of the innovation process. In GRLmobile, the high touch service is to ignite the customers' passion for fashion, gossip, music, movies and the experience of 'girl talk' via GRL mobile phones. In Stretchtex the customer is closely involved in the product specification and the needs analysis for the new products. In Lonely Planet and Microsoft, there is extensive testing of customers' reactions to new offerings. Lead customers are the beta testers, and indeed are a direct source of new product and service features in these companies. Toyota's focus and spectacular success with waste reduction is geared towards driving for higher value in its offerings, in the sense of 'more car with more features and more durability and reliability of vehicles' for a lower cost and price. While this customer obsession is less evident in a commodity industry such as Newcrest's gold and copper

markets, this mining price-taker is cost and productivity focussed and also considers its customers to include stakeholders such as staff, local communities that it serves and the environment.

NOTES

4.3.3 Competitive Spirit

Most creative and innovative departments in an organization regard competitiveness as an important aspect of their culture. According to Read (1996), competitiveness in organizations has shifted to the creation and assimilation of knowledge. In creating a culture of competitiveness managers should reach out to internal and external knowledge, encourage debating of ideas, create an environment in which constructive conflict will lead to information flow, support projects based on information flow and actively manage the choice of organizational design. Support for change is a value that will influence creativity and innovation positively (Arad et al., 1997; Tushman and O'Reilly, 1997). Managers can create a culture that supports change by looking for new and improved ways of working; creating a vision that emphasizes change and revealing a positive attitude towards change (Arad et al., 1997; Tushman and O'Reilly, 1997). An example of a culture in which change is supported is to expect personnel, when stating their annual objectives for the year, to indicate how they intend changing their work methods.

4.3.4 Failure Tolerance

In the high risk-taking case, decisions and actions are prompt and rapid, arising opportunities are taken and concrete experimentation is preferred to detailed investigation and analysis. In a risk-avoiding climate there is a cautious, hesitant mentality. People try to be on the "safe side". They decide "to sleep on the matter". They set up committees and they cover themselves in many ways before making a decision.

Risks are often difficult to anticipate and despite best efforts and world class systems of market intelligence and forecasting, how could Toyota (or anyone else) have seen the 2008–2009 global financial crisis coming, well enough in advance so as to plan and adjust resources and production for it? Despite implementing excellent quality control, Toyota fell prey during 2009–2010 to quality problems in some of their vehicles. Some things cannot be anticipated, it would seem, even for excellent companies. Others can be anticipated as a range, such as the richness and size and unit cost of a gold seam in a Newcrest Mining operation, or the extent of success of a new mining technology, or the sales volume of a new version of Microsoft Office. Hence companies that aspire to be innovative must be prepared to take risks, and hence have an appetite for some risk, and a tolerance of efforts that result in failure.

4.3.5 Organisational Support

The ways new ideas are treated. In a supportive climate, ideas and suggestions are received in an attentive and supportive way by bosses and workmates. People listen to

each other and encourage initiatives. Possibilities for trying out new ideas are created. The atmosphere is constructive and positive. When idea support is low, the reflexive "no" prevails. Every suggestion is immediately refuted by a counter-argument. Fault finding and obstacle raising are the usual styles of responding to ideas.

NOTES

4.3.6 Managing Ambiguity and Paradox

Innovation cannot occur without ambiguity, and organizations and individuals that are not able to tolerate ambiguity in the work place environment and relationships reproduce only routine actions. Innovative structures, for example, cannot have all attendant problems worked out in advance. Leaders need to build a deep appreciation of this fact; otherwise there will be a tendency to create cultures of blame. Tolerance of ambiguity allows space for risk taking, and exploration of alternative solution spaces, which do not always produce business results. This hedges against constant deployment of tried and tested routines for all occasions. Tom Peters comes close to the mark in highlighting that most successful managers have an unusual ability to resolve paradox, to translate conflicts and tensions into excitement, high commitment and superior performance.

Case Studies: Ferguson Plarre: Innovation and Sustainability Intertwined

Steve Plarre and his brother Michael have in recent years assumed operational control of the 100 year old company founded by their great grandfather and built by their father, then merged with the Ferguson operation into what it is today, Ferguson Plarre Bakehouses. The Ferguson side of the business operates the retail side of the partnership and the Plarres run the 'upstream' manufacturing operation.

From their state-of-the-art facility in northwest Melbourne, the business creates and produces a range of bakery products, sold through the network of 48 stores in Victoria. The company has won a prestigious award for sustainable development, which has brought both competitive advantage, and a market edge:

"We have done a lot in sustainable development. Our market and industry are not especially 'green' oriented; however we will lead them there. Having said that, we have to market the 'green image' very carefully because of the potential for harmful and incorrect price perceptions in consumers" (Steve Plarre).

Some examples of sustainable development initiatives that have been innovative have been new efficient equipment use such as a new heat reclaimer, which reduces substantially the water heat load in the business. Moving also to gas has reduced total energy consumed and saved costs.

Ferguson Plarre has learned a lot from and also gives knowledge back actively to the industry association (BIAV, Bakery Industry Association of

Check Your Progress

Fill in the Blanks:

4. The freedom to set one's own agenda is called as ....
5. .... encourages a sense of individual and promotes enterprenuerial spirit.
6. .... is first seen as a way to create new forms of value for customers, in addition to internal cost and efficiency related innovation.

Victoria), which is a form of its open innovation. The company has also done a lot in its new facility to achieve energy efficient climate control, such as through its highly efficient air conditioning system.

The Ferguson Plarre market position is about "halfway up the market", being known as good quality Australian fare, and its nearest direct competitor is the Michel's Patisserie business. Of its 48 store network, most (45) are franchised and only three are owned by the Ferguson Plarre business. Ferguson Plarre chooses not to produce bread, with differentiates it from Bakers Delight, Brumbies and other bakery chains, as a matter of conscious strategy. Ferguson Plarre has a strategy of differentiating its brand based on history, family baking, sustainability differences and innovation.

Ferguson Plarre has not attempted to patent products, but does protect its company name. It uses trademarks of products to get a competitive edge, and many local consumers would know of its products Tiddly Oggie and Sponge on the Run as examples of its unique offerings to the Victorian market. Further innovations have been the recent web based DesignaCake service. Celebration cakes such as birthday cakes represent 15% of Ferguson Plarre's revenue, and for these it is now possible for consumers to upload a photo via the web and design and order such cakes online. It also operates an image library, which customers can choose from, of over 300 images. This business is complex and due to the high variety and low volume, it has previously not been a high margin product line but that is changing with innovations like DesignaCake.

Although it has had a long term family branding image, it has been challenging to truly differentiate the company. The equipment and the raw materials are essentially standard across the industry. Ferguson Plarre's new product success rate averages approximately 10%, which is standard for this and even other similar industries. Ferguson Plarre is ramping up its effort and the discipline of its processes in looking for new fashion products and services. Examples are take home pies, which became an opportunity during the global financial crisis as people worked longer and ate out less, and "Sex in the City" cupcakes. The company tries to keep ahead by closely observing social trends, such as needs for comfort foods, and by entering award competitions which will allow it a market edge.

Two examples of products that it tried and quickly withdrew from the market, after slow sales, were its Beef and Beer flavoured pie, and its Aphrodisiac Cake. Although differentiation through new products is challenging, every few months it launches a new product idea.

With some 120 staff comprising full and part timers, equivalent to some 90 full time equivalents, new product development is championed and catalysed by three key individuals. Everyone's best ideas are welcomed and are evaluated. Open innovation is practised and the senior managers travel the world looking

NOTES

for new product and service ideas. From a recent international study tour, Steve Plarre and others brought back and implemented a total of 10 new products.

Ferguson Plarre leadership style is seen as important in driving forward on innovation and sustainable development activities and outcomes. The open innovation is fostered through a leadership style characterised as enthusiastic, lead-by-example, 'super-open-door' and family atmosphere. All employees bring ideas forward and successes are celebrated with enthusiasm. The leadership style is:

"We shepherd people from behind, let people go with their ideas, through a participative style" (Steve Plarre).

Mike Plarre and others have the requisite technical and process knowledge to develop new product cooking and formulation procedures. Ferguson Plarre operates a test kitchen and has a skilled baker who works on these new product ideas. The new product decisions are taken based on an expected ROI and minimum gross profit margins but without formal budgets. However the company has grown to a size where budgets are being developed generally for the first time. Steve Plarre is the engine of innovation, and he is responsible for embedding it in the culture and behaviours of the company. Their key criteria is that any innovation must bring differentiation (hence brand value) or profit or both. Although the company has not had traditionally many formal operating measures, it is now implementing these, and for innovation effectiveness this is a KPI of 5% of sales each year expected to be from new products.

Staff at Ferguson Plarre are recognised for their contributions to innovation, although this is quite informally done. Movie vouchers have been used quite a lot. Recognition symbols such as lunches and dinners have been given out. Flexibility of hours has also been a reward. A good deal of non-financial rewards has been used also, and the company newsletters also gives recognition to innovation contributions. This fits the culture of this family oriented company, which has many loyal long term staff and low turnover of those staff. The company pays above industry averages and award levels and has many groups of family members working in it. Staff are recruited and brought in based on their cultural and talent/skills fit.

While the owners and senior leadership team are seen as the critical catalysts of innovation, there are some staff who are not yet highly innovative in their approach. They are resistant to change. While the managers try to be proactive and innovative in their actions and style, they recognise their limitations in having been insular and worked only in this company and industry, hence needing to make large efforts to become 'worldly' enough to stay at the edge of innovativeness. The company style is open, having worked with an open innovation process in its facility design, with suppliers, equipment suppliers and even with non-direct competitors.

NOTES

The company backs its innovations with a well structured set of process and disciplines which are unusually strong for a small family company. Recipes are all documented, and Lean systems through '5S' have been implemented. Weekly management meetings are held with a formal agenda. Systems for formal induction are used and the company has established and uses OH&S and risk management systems. It has a formal food safety plan in place and working well.

New product developments at Ferguson Plarre are required to meet the following objectives:

- Grow sales
- Appeal to new markets
- Increase seasonal sales
- Create a point of difference
- Take advantage of market trends

The desired outcomes are increased profitability for franchisees and the Ferguson Plarre company, and increased brand value. New product goals are to achieve any of increased shelf life, profitable pricing, vegetarian options and differentiation. The new product development process involves annual planning, input from retailers, creation of a new product list and a timetable for product release. Business outcomes and goals include primarily new product sales as a proportion of total, profitability of new products compared to the company average, and sales volume of new products during launches. A detailed step-by-step approval and sign-off process has been defined.

The key to continued business success at Ferguson Plarre is clearly its leadership, including substantially its leadership of innovation capability and sustainability activities.

4.4 SUMMARY

- Innovation can result in spectacular success for an organization for example Apple computer changed the face of the computer industry when it introduced its personal computer.
- Facebook, which is just turning six, has achieved a level of maturity most wags thought would never come.
- Amazon redefined traditional book retailing through a radically different approach: online, over the Internet.
- One of Apple's significant achievements has been "the implementation of the office workplace of tomorrow".

- Google has triumphed through innovation. When it was launched in 1998, it quickly became the search tool of choice for the professional researchers due to the superior relevance of its results coupled with its ease of use and large index of websites.
- Novartis sets strategic objectives for the timing and number of its commercial product launches.
- Walmart's core competence can be said to be its knowledge achieved by its inventory management skills with its supply chain management facilitated by its innovations like the cross-docking techniques and its innovation in information technology and in relationship strategy maintained with its customers, suppliers, and associates and its cost strategy achieved with its scale of operations.
- The platform leadership strategy of Intel contained three major rules—sponsoring innovations in PC architecture, stimulating external innovations on complements, and finally, coordinating industrial innovation.
- Innovation has touched the cricket in every field-the way game is played (20-20, ODI, Test), shape and size of bats, innovative batting and bowling techniques (the class of some individual genius like paddle sweep of Sachin Tendulkar, doosra of Saqlin Mustaq, Marillier shot of Douglas Marillier and so on) and so on.
- Microsoft's strategy was to rely on making its own complements—thus the development of applications like Word, Excel, Outlook, e-mail, scheduler and even an information manager embedded in Windows.
- Despite the interest in the field of innovation, much of the research evidence concerning management practices about innovation cultures and creative climate remains unsystematic and anecdotal.
- Operational autonomy encourages a sense of the individual and promotes entrepreneurial spirit, whereas strategic autonomy is more to do with the level of alignment with organizational goals.
- Most creative and innovative departments in an organization regard competitiveness as an important aspect of their culture.
- In a risk-avoiding climate there is a cautious, hesitant mentality. People try to be on the "safe side". They decide "to sleep on the matter". They set up committees and they cover themselves in many ways before making a decision.
- Innovation cannot occur without ambiguity, and organizations and individuals that are not able to tolerate ambiguity in the work place environment and relationships reproduce only routine actions.

4.5 KEY TERMS

- **Innovation:** Innovation is the process by which organisations use their resources and competences to develop new or improved goods and services

NOTES

or to develop new production and operating systems so that they can better respond to the needs of their customers.

- **Autonomy:** Autonomy is defined as having control over means as well as the ends of one's work.

4.6 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Facebook page
2. 90
3. Wal-Mart
4. Strategic Autonomy
5. Operational autonomy
6. Innovation

4.7 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the key innovative features of the following firms?
   - Facebook
   - Apple
   - Google
   - IPL 20-20
   - Microsoft
   - GE
2. Write a note on organizational climate for creativity and culture.
3. Define Autonomy and Entrepreneurship.

Long-Answer Questions

1. What are the key characteristics of an innovative organization?
2. Discuss the importance of organization support for encouraging organization innovation.

NOTES

UNIT 5 PATENTING OF INNOVATION

Structure

5.0 INTRODUCTION

Innovation and R&D efforts lead to generation of intellectual wealth. Researchers and technologists are primarily responsible for the creation of such intellectual wealth. But it is not only important to genearate such wealth, it is equally, if not more, important to protect such wealth. This is because it is tile intellectual wealth of a country or organisation that alone counts in the current global context of conducting trade and business. In the present day world, it is important for all nation or organisation to take full advantage of its intellectual wealth. It is only by claiming and protecting rights over such intellectual wealth, termed as Intellectual Properly Rights (IPRs), that one can gain a competitive edge or merely survive in the current scenario.

Intellectual property is that property which results from the intellectual efforts of individuals or organisations, in other words such property is the creation of the human mind and human intellect. The ownership of property of any kind is always required to be protected in order to prevent such property from being misappropriated or misused. The rights associated with the protection of this intellectual property are referred to as Intellectual Property Rights (IPR).

5.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Explain Patenting inventions and innovations
- Discuss role of patents, copy rights, trade marks and license in innovation and R&D management.

5.2 PATENTING INVENTIONS AND INNOVATIONS

NOTES

The patent is the most important form of Intellectual Property. A Patent is a legally protected property right that confers on its holder the exclusive right in the invention for a limited period. Such rights are conferred by the Government to an applicant for disclosing an invention to make, use and/or sell the invention, for a limited period, as per the applicable law of that Government.

The rights in a patent can be enforced only in the country or countries which have granted the patent. Such rights are not valid in other countries. A patent right is, therefore, a government granted and secured legal right which prevents others from making, using or selling i.e. 'practising' the inventions covered by the patent. This makes the patent a personal property, which can be licensed or sold like any other property.

Anybody who makes, uses or sells the invention without the permission (i.e, license) of the patent owner, also called 'patentee', is said to have infringed his (i.e, the patentee's) patent.

To draw an analogy, it is like trespassing in a hotel or a house or any other property and using it without taking the permission of the owner. Just as such trespassers are fined so also those who infringe others' patents have to pay dearly. One basic purpose of granting patents is to encourage inventive activities. The 'patentee' is the person, who is granted the rights relating to patent. The patentee has an obligation in that the invention covered in the patent is worked in India on a commercial scale and to the maximum possible extent without undue delay and the patented invention is available to the public on reasonable terms.

In India, patent rights are governed by the Patents Act of 1970. The responsibility lies with the Controller General of Patents, Designs and Trade marks under the administrative control of the Ministry of Industry. A patentee in India gets exclusive rights to make, use, exercise, sell or distribute the patented invention, in the case of it being an article or substance. Where the patent is granted for a method or process of manufacture, he gets the exclusive right to use or exercise the method or process.

The following are the key inventions that are eligible for patent:

- Process for the production of a new compound
- Improvement of existing process for production of known compound/ composition
- Development of new machine or device
- Improvement of an existing machine or device
- Development of a synergistic composition

A process can be termed as an invention if the process of manufacturing requires at the minimum, one or more inventive steps. It really does not matter even if the steps involved are extremely simple.

The given below is the list of inventions that are not patentable:

- Frivolous/against well established principles
- Use against lawful practice/injurious to public health/morally wrong
- Scientific principle/abstract theory
- Discovery of new property/use of a known substance
- Discovery of new use of a known process/machine/apparatus (without new product generation or using no new substance)
- Simple admixture or process for creating one
- Arrangement/Duplication of features of known devices
- Testing procedure for making process/equipment more efficient
- A method of agriculture/horticulture
- Atomic energy related

5.3 ROLE OF PATENTS, COPY RIGHTS, TRADE MARKS AND LICENSE IN INNOVATION AND R&D MANAGEMENT

Role of Intellectual Property Right (IPR) lay in providing a legal right to the inventor to protect his/her creation as well as preventing others from illegally exploiting the creation and thus avoid re-invention of the wheel.

"Your ideas are your property and you have every right to benefit from it" - is the core ethos around which intellectual property rights have been formulated. These are the rights given to a person over the creation of his own mind. The chief purpose is to encourage inventiveness and research that leads to new ideas and the development of new technologies.

The following sanctions discuss the meaning and role of patents, copy right trade marks and license in innovation and Research and Development (R&D) management:

5.3.1 Patents

A patent is an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem.

The protection is granted for a limited period, usually 20 years (as stipulated in the TRIPS agreement). The patent is a title of ownership. Patent protection means that the invention cannot be made, used, distributed or sold on a commercial scale without the patent owner's consent. These patent rights are usually enforced in a court, which in most systems holds the authority to stop patent infringement. Conversely, a court can also declare a patent invalid where it is successfully challenged by a third

party. On registration and the grant of rights, annual fees are charged by the relevant authorities to maintain them.

A patent does not give its owner the positive right to use the patented invention. Third parties may have to be requested. A patent owner has the right to decide who may or may not use the patented invention throughout the period during which the invention is protected. The patent owner may give permission to other parties, or license them, to use the invention on mutually agreed terms. The owner may also sell the right to the invention to someone, who then becomes the new owner of the patent.

5.3.2 Copy Rights

Copyright is a legal term describing rights given to creators for their literary and artistic works. The kinds of work covered by copyright include literary works, such as novels, poems, plays, reference works, newspapers, computer programs, databases, films, musical compositions and choreography, artistic works such as paintings, drawings, photographs and sculpture, architectural works, advertisements, maps and technical drawings.

The creators of original works protected by copyright, and their heirs, have certain basic rights. They have the exclusive right to use or authorize others to use the work on agreed terms. They can prohibit or authorize:

- its reproduction in various forms, including printed publication or sound recording
- its public performance, as in the case of a play or musical work
- its recording, for example on compact disc, cassette, or videotape
- its broadcasting, whether by radio, cable or satellite
- its translation into other languages, or its adaptation, such as that of a novel into a screenplay

5.3.3 Trade Marks

A Trade Mark is a visual system in the form of a word, a device or a label-applied to an article of manufacture or sale with a view to indicate to the consumer about (lie origin of manufacture of goods, affixed with that mark. It therefore, helps to distinguish such goods from similar goods manufactured by others in the same trade.

The registration of trade mark is important because it creates a link between manufacturer and the customer. It is an excellent instrument of publicity and a symbol of goodwill apart from being a property which can have an enormous economic potential.

The consumer uses the trade mark to choose goods while purchasing. The normal consumer would only be aware of such brand names associated with different hems of consumption.

In a larger sense, trademarks promote initiative and enterprise worldwide by rewarding the owners of trademarks with recognition and financial profit. Trademark

protection also hinders the efforts of unfair competitors, such as counterfeiters, to use similar distinctive signs to market inferior or different products or services. Trademarks may be one or more words, letters or numerals or a combination of all three. They may consist of drawings, symbols, three-dimensional shapes such as the outward form and packaging of goods, audible signs such as music or oral distinguishing features or smells.

This right is accrued under the Common Law Rights but registration provides better protection as the Certificate of Registration would be prima facie evidence of the proprietor's title to the trademark. Therefore, manufacturers generally find it advisable to register their trade marks against infringers of their rights, it must be noted that as compared to tire protection of inventions by patents, where the publication of an invention prior to making an application for patent would be a bar for patenting as just explained above, in the case of a trade mark the established use of mark prior to making an application for registration of the mark would be beneficial.

5.3.4 License

A license is a contract which awards to a party other than the owner of the intellectual property the right to make, use, sell or import products or services based on the owner's intellectual property. Licenses may be awarded on an exclusive or non-exclusive basis and may provide for payment of license fees, milestones, royalties, or other income to the owner of the intellectual property.

It is recognized that the protection of proprietary rights in the form of a patent or copyright is often necessary to encourage a company to risk the investment of its human and financial resources to develop the invention. In some cases an exclusive license may be necessary to give a company the incentive to undertake commercial development and production. Non-exclusive licenses allow several companies to exploit an invention.

Increasingly, products are made locally and not shipped round the world; but the ability to make them may still depend on technology and techniques patented or laboriously acquired elsewhere. Business people are prepared to pay for knowledge that they require, and they find this the most cost-effective way of developing a new business. When a company buys a license, the main thing it sees itself buying is the ability to manufacture a product safeguarded by a patent, which otherwise would be illegal to use.

5.4 INTELLECTUAL PROPERTY RIGHTS

Any organisation having technology invariably has to deal with one or the other form of Intellectual Property that has been described so far, in order to remain competitive and productive. It is therefore, obvious that management of Intellectual Property is an important component of innovation management in an organisation by which

process alone an organisation can combat against its competitors and thrive in the current competitive situation.

An individual inventor with limited resources would nave to manage his intellectual property differently from a National R&D Laboratory or academic institution. So also in-house research and development units of industry would have to tackle this issue as also large business houses and multinational corporations with many inter-country deals. Each would have its own strategy to deal with the issue.

The various tools of IPR that are used to protect innovations are:

- **Copyright:** Copyright is concerned with protection of creative works that are musical, literary, artistic, lectures, plays, art reproductions, models, photographs, computer software, etc.
- **Patent:** Patent pertains to pragmatic innovations and aims to protect inventions that are novel, non-obvious and useful.
- **Trademark:** Trademark is related to commercial symbols and concern to protect distinctive marks such as words/signs including personal names, letters, numerals, figurative elements (logos); devices; visually perceptible two or three dimensional signs/shapes or their combinations; audible signs (sound marks) e.g. the cry of an animal or laughing sound of a baby; olfactory marks (smell marks), use of certain fragrance.
- **Industrial Designs:** Industrial Designs protects novel nonfunctional features of shape, configuration, pattern, ornamentation or composition of lines or colours, applied to any article either two or three dimensional or in both forms by any industrial process or means whether manual, mechanical or chemical, separate or combined which in the finished article appeal to and are judged solely by the eye.
- **Geographical Indications (GI):** Geographical Indications (GI) are defined as that aspect of industrial property, which refers to the country or to a place of origin of that product. Typically, such a name conveys an assurance of quality and distinctiveness of the product, which is essentially attributable to the fact of its origin in that, defined geographical locality, region or country.

IPR has to be renewed from time to time to ensure the protection of the rights from any infringement.

The management of IPR does not merely cover the mere procedure related to procurement of the rights described so far, be they relating lo patents, designs, trade marks or copy rights. The issue does not also merely extend to the licensing stage beyond commercialization. It must be understood that the issue has much broader connotations. It covers the administration of all phases of management of these rights starting right from idea generation or conceptualization stage of an invention through the various intermediate stages finally to commercialization and licensing and further beyond to the next new idea generation stage.

The following are the key related to the management of IPR:

1. The commercial potential of any research undertaken should be assessed. This is because, as already mentioned, it is essential to file an application for patent with at least provisional specification at the earliest, in order to establish priority for consideration of ownership and thus gain precedence over competitors and rivals.
2. All the scientists and technologists in the organisation should be aware of the importance of various Intellectual Property Issues and of the consequences to the organisation of bad handling of the same.
3. The patentability of the invention should be assessed carefully keeping in account all the considerations mentioned.
4. It should be understood that completing the procedure of patenting is both costly and time consuming and hence due consideration should be given to the potential advantages that could be accrued, before initiation of action for filing of patent.
5. The time for filing the patent should be very carefully chosen. As mentioned earlier, the most ideal stage is when the idea is fully conceptualized. The invention can be properly protected only if the time for patenting is appropriately selected.
6. Decisions relating to licensing of a patent or sale of a patent should be taken carefully depending upon several issues like the manufacturing and marketing strengths for that line of product which relates to the invention, potential commercial benefit through licensing vis a vis sale etc.
7. A systematic procedure for record maintenance should be in place. Complete record of all activities right from the conceptualization stage through the various stages is essential.
8. Technological trends in the field of research undertaken should be continuously tracked. Regular patent information scan should be undertaken.
9. In respect of ownership of invention the employer-employee relationship should be clearly stated in a contract. There should be provision, for sharing of benefits and for ensuring confidentiality of the know-low and technical information under any eventuality whatsoever.
10. In the case of joint R&D collaborations between Industry and R&D or academic institutions or even international cooperation programmes the ownership of invention and the confidentiality aspects should be clearly stated in a contractual form right at the start of the collaboration.

Check Your Progress

Fill in the Blanks:

1. The .... is most important form of intellectual property.
2. .... is a legal term describing rights given to creators for their literary and artistic works.
3. The registrations of .... creates link between customers and manufactures.

5.5 DECISION SUPPORT SYSTEM IN RESEARCH AND DEVELOPMENT (R&D)

NOTES

The DSS involved a combined approach developed for analyzing portfolios of technology investments, multi-criteria decision analysis, Monte Carlo simulation, and mathematical programming techniques were used to enumerate every possible technology portfolio combination to identify high science-value missions and technologies that could be funded within a specified budget. This was done in a stepwise fashion by simulating the uncertainties in every technology required by every mission.

The methodology implemented within the DSS was composed of steps to define and specify the inputs for the calculation portion of the DSS software. The five steps are listed below:

- **Step 1.** Define projects to deliver science benefits.
- **Step 2.** Define technology developments needed to enable projects.
- **Step 3.** Build road map to link required technology to projects and identify dependencies between technologies.
- **Step 4.** Gather data for each technology.
- **Step 5.** Exercise the computational portion of the DSS to identify the highest value technology portfolio.

Benefits Provided by the Decision Support System

The DSS enabled a systematic approach to four critical issues facing the Mars Exploration Program:

- Including technological uncertainties.
- Identifying key technologies and their risks to candidate mission concepts.
- Linking science objectives to technology selection.
- Cost and budget limitations on the selection of feasible technologies.

5.6 PROCESS VS PRODUCT INNOVATION

Innovation connotes something that is essentially new, however to create business value, it does not necessarily have to be 'new to the world'. It can be new to an industry, or new to your customers, or a new advance to your internal processes and hence cost reducing. It can be a new business model. Clearly it can be new products, services, technologies, or processes. And there is no value in it being new for the sake of being new. It must be new (meaning different to some extent) and value creating to be a successful innovation.

Product Innovation

Product innovation involves coming up with something new (or sufficiently different). Successful startup companies begin with product innovation; they either come up

with a significantly better product or a new product altogether (like the first Web browser). Small nimble companies find it much easier to do this in part because they are willing to take risks (and because they have less to lose). Organisations at this stage are often characterised by what has been called the 'handcraft syndrome': everything is done by hand with few systems in place to automate things (in part because everything is new and being developed 'on the fly').

The Dyson bagless vacuum cleaner is an example of a product innovation. James Dyson developed what he terms 'dual cyclone' technology (Dyson, 1997) and used it to create a new more efficient vacuum cleaner. As a vacuum cleaner it is a consumer product and what makes it an innovation, i.e. what is 'innovative' about it, is that it functions in a quite different way from a conventional vacuum cleaner. It is still a vacuum cleaner and it does what vacuum cleaners have always done, it extracts dust and other items of household debris from carpets and upholstery. But the innovation lies in the way in which it functions. Instead of employing a fan to suck dust into a bag, it dispenses with the bag and uses Dyson's patented 'dual cyclone' technology to extract dust and place it in a clear plastic container. It is a nice example of a product innovation because it is an everyday household product where you can actually see the innovation at work, a fact that James Dyson, an experienced industrial designer and entrepreneur, no doubt had in mind when he designed his first bagless vacuum cleaner, the Dyson 001.

From a commercial perspective the attraction of product innovations is that the novelty of a new product will persuade consumers to make a purchase. It is no surprise that 'new product development' is one of the four business strategies put forward by Ansoff for the future development of a business. Of course product innovations don't have to be consumer products; they can just as easily be industrial products such as machinery and equipment.

Process Innovation

If service innovations come second behind product innovations, then process innovations almost certainly come a poor third. And yet process innovations often have an even bigger impact on society than either product or service innovations. The early nineteenth century Luddite movement in and around Nottingham(Chapman, 2002), where stocking knitters who worked on machines in the home, took to rioting and breaking the new more efficient machines located in factories, because they feared that the new machines would destroy their livelihoods, is testimony to the power of process innovations.

Although generally less well known than product innovations, examples of process innovations, including ones that have had a dramatic impact on society as a whole, abound.

The humble photocopier, developed by Chester Carlson, may not sound like a spectacular innovation, and yet it had a big impact on the way in which administrative systems in offices are organised. One has only to look at what happens in an office

NOTES

when the photocopier breaks down to see how reliant we are upon it. Much less well known, but just as significant in terms of its impact on society, is the Float Glass process developed by Alistair Pilkington, in which plate glass is manufactured by drawing glass out across a bed of molten tin (Quinn, 1991). Prior to the introduction of this process innovation, plate glass used for shop windows and office windows was expensive and of poor quality largely because the only way of getting a flat surface was to grind it and polish it. The Float Glass process at a stroke eliminated the need for time consuming grinding and polishing it, leading to a dramatic fall in costs. Architects and property developers could now afford to specify large sheets of plate glass when constructing new buildings, where in the past they would have been prevented because of the cost. The result can be seen in the public buildings constructed in the last thirty years, where everything from office blocks and hotels to airports and shopping malls now employ large expanses of glass.

Case let: South West Airlines

Founded in the late 1960s by Herb Kellner, it was South West Airlines that started the 'no frills' revolution in air travel. In Europe in the last 10 years air travel has been transformed by the introduction of low cost services offered by 'no frills' carriers. The innovation which these carriers introduced has been the provision of easily accessible scheduled short haul services at fares very much lower than those offered by conventional scheduled airlines. The result has been an enormous increase in both numbers travelling by air and the range of destinations served.

Yet this was not a European innovation. The pioneer of low cost 'no frills' air transport was South West Airlines based in Texas. Under its charismatic founder, Herb Kellner, South West Airlines had to fight legal battles with local competitors for the first four years of existence just to be allowed to fly. Competitors argued there simply wasn't enough business to warrant another airline in the region. When it did finally get airborne it was faced with a price war with Braniff and other airlines as they tried to drive it out of business

Based at Love Field in downtown Dallas South West Airlines was able to survive by offering customers a very different package from conventional airlines. The package included low fares (usually 60% below conventional airlines), high frequencies, excellent on-time departure rates and direct sales (i.e. no travel agents). What was not being offered was meals, pre-assigned seats, different classes of seating and connecting flights. This was achieved by means of: a single aircraft type (then and now the Boeing 737), smaller low cost airports, rapid turnarounds (typically 15-20 minutes), high load factors, and point-to-point services (Procter, 1994).

The 'no frills' service package diverted some traffic away from existing carriers but more significantly it generated a lot of new business, especially

NOTES

leisure and business passengers who could be persuaded to fly rather than drive. As Herb Kellner put it, 'we are not competing with airlines, we're competing with ground transportation'. De-regulation of airline services in the US in 1978 meant that South West Airlines was well placed to expand in Texas with this innovation in airline service. Traffic growth proved well above average. South West was able to expand by adding more capacity to its fleet, but instead of adding routes as airlines normally did Kellner's strategy was to increase flight frequency on existing routes.

It worked. Today South West Airlines is the fifth biggest carrier in the US, and is the most consistently profitable airline in the country. Yet it has stuck to its innovative business model. Not only that, but the model has been copied with great success in Europe, first by Ryannair (Doganis, 2001) and then by a host of other airlines including EasyJet and BMI Baby to create a low cost revolution in air travel across the continent.

5.7 REVERSE ENGINEERING

Reverse Engineering (RE) is the decompilation of any application, regardless of the programming language that was used to create it, so that one can acquire its source code or any part of it. The reverse engineer can re-use this code in his own programs or modify an existing (already compiled) program to perform in other ways. He can use the knowledge gained from RE to correct application programs, also known as bugs. But the most important is that one can get extremely useful ideas by observing how other programmers work and think, thus improve his skills and knowledge.

Here are just a few reasons that RE exists nowadays and its usage is increasing each year:

- Personal education
- Understand and work around (or fix) limitations and defects in tools.
- Understand and work around (or fix) defects in third-party products.
- Make a product compatible with (able to work with) another product.
- Make a product compatible with (able to share data with) another product.
- To learn the principles that guided a competitor's design.
- Determine whether another company stole and reused some of source code.
- Determine whether a product is capable of living up to its advertised claims.

Not all actions performed can be considered "legal". Hence, extreme caution must be taken, not to violate any copyright laws or other treaties. Usually each product comes with a copyright law or license agreement.

5.8 LAW REGARDING THE PROTECTION OF INNOVATION FROM LIMITATIONS

NOTES

Intellectual property (IP) is the creation of human intellect. It refers to the ideas, knowledge, invention, innovation, creativity, research etc, all being the product of human mind and is similar to any property, whether movable or immovable, wherein the proprietor or the owner may exclusively use his property at will and has the right to prevent others from using it, without his permission. The rights relating to intellectual property are known as 'Intellectual Property Rights'.

Intellectual Property Rights, by providing exclusive rights to the inventor or creator, encourages more and more people to invest time, efforts and money in such innovations and creations. Intellectual property rights are customarily divided into two main areas:

- Copyright and rights related to copyright:- the rights of authors of literary and artistic works (such as books and other writings, musical compositions, paintings, sculpture, computer programs and films) are protected by copyright. Also, protection is granted to related or neighbouring rights like the rights of performers (e.g. actors, singers and musicians), producers of phonograms (sound recordings) and broadcasting organizations.
- Industrial property, which is divided into two main areas:
    - One area can be characterized as the protection of distinctive signs, in particular trademarks (which distinguish the goods or services of one undertaking from those of other undertakings) and geographical indications (which identify a good as originating in a place where a given characteristic of the good is essentially attributable to its geographical origin).
    - Other types of industrial property are protected primarily to stimulate innovation, design and the creation of technology. This category includes inventions (protected by patents), industrial designs and trade secrets.

The issue of Intellectual Property Rights was brought on an international platform of negotiation by World Trade Organization (WTO) through its Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS). This agreement narrowed down the differences existing in the extent of protection and enforcement of the Intellectual Property rights (IPRs) around the world by bringing them under a common minimum internationally agreed trade standards. The member countries are required to abide by these standards within stipulated time-frame. India, being a signatory of TRIPS has evolved an elaborate administrative and legislative framework for protection of its intellectual property.

5.8.1 WIPO and International Systems for Protection of IPR

The World Intellectual Property Organisation (WIPO) located at Geneva is a specialized agency of the United Nations System that seeks to promote international

Check Your Progress

Fill in the Blanks:

4. .... innovation involves coming up with something new or significantly different.
5. .... is the decompilation of any application, regardless of the programming language that was used to create it so that one can acquire its source code or any part of it.
6. GATT stands for ....

cooperation in the protection of international property. The convention, establishing the WIPO has defined Intellectual Property Rights to mean those rights relating to: literary, artistic and scientific work: performances of performing artists, phonograms and broadcasts; inventions in all fields of human endeavour; scientific discoveries; industrial designs; trade marks; service marks and commercial names and designations; and all other rights resulting from intellectual activity in the industrial, scientific, literary and artistic fields.

Currently, there is no single way to obtain truly international protection of Intellectual Property but there are several conventions, which have been established between certain member countries to provide minimum norms of Intellectual Properly protection:

- The Paris Convention is the International Convention for the protection of Intellectual Property and is probably the single most important multilateral treat)'.
- The Berne Convention is the principal trans-national convention relating purely to copyright protection. India is a member of this convention.
- The European Patent Convention has created the European Patent Office (EPO) based at Germany. The convention applies to most European Economic; Community (EEC) member countries apart from other European countries. A single application in English, German or French is accepted.
- Patent Cooperation Treaty (PCT) includes many countries in addition to European countries. A single application designating the member countries from which patents are desired is acceptable.
- The Madrid Agreement concerns international filing of registration applications for trade mark. It enables registration of a trademark in WIPO's International Bureau in Geneva.
- The North American Free Trade Agreement (NAFTA) is a general trade agreement between Canada. Mexico and USA that imposes general requirements for both domestic and international treatment of IPRs.

5.8.2 TRIPS

The Uruguay round of international trade negotiations launched under the auspices of the General Agreement on Tariff and Trade (GATT) has resulted in a set of agreements including one on Trade Related aspects of Intellectual Property Rights (TRIPS). The TRIPS is an important agreement that requires member countries to adopt a certain minimum standard of Intellectual Property Protection.

Under this agreement member countries are obliged to re-write national laws to make them confirm to internationally agreed norms of protection of IPRs. The areas of protection have also been broadened to include technological areas, which are not currently protected in many countries, include pharmaceutical products, computer softwares, geographical terms and others. It has also led to the establishment of a World Trade Organisation (WTO) for the management of international trade and international dispute settlement procedures. The WTO is due to come into existence in 1999.

NOTES

Case Study: Lonely Planet; brand and innovation go together

Gus Balbontin, Global Innovation Manager for Lonely Planet, works mostly in its head office in Melbourne, Australia. His title is 'global innovation manager', and his key responsibilities are to drive and deliver innovations of all forms to the company, yet he has no staff and limited budget. He engages in 'Guerrilla Warfare Innovation':

"What works best here is to light fires and let them spread: try not to force it because that kills it" (Gus Balbontin). The Lonely Planet culture wouldn't permit or allow a formalised approach to innovation. The approach is to have irregular but carefully orchestrated 'hack days' in which ideas are brought up from groups of staff and quickly tested and prototyped, then evaluated by a cross section of staff from around the company. These hack days create a buzz of invention and innovation in the company.

Gus manages this innovation process, but it needs the creativity and innovation efforts of a large group of the company's 600 staff.

Gus employs an innovation concept which is a process of moving from 'inspiration to realisation'. It requires a balance of creativity and a harnessing of the forces of randomness and chaos in the early stages of a concept's development, through various stages of increasingly disciplined control, plans, governance of the innovation, allocation of resources, process management etc. Throughout this process, Gus and his senior colleagues are careful to apply the right style of leadership and management as needed to encourage and control these processes.

The process at Lonely Planet involves a series of steps:

1. Inspiration, meaning the inside and outside sourcing of innovative ideas
2. At the hack days, idea generation leads to rapid development, creativity and simulation of product/service mock-ups
3. Experimenting and prototyping, involving 'guerrilla warfare'
4. Choosing, prioritising and then 'projectising' and delivery

Gus Balbontin and Lonely Planet have found step 3 above to be the critical and challenging step.

Hack days involve idea generation and prototyping, so that coming out of the hack days are the tested ideas.

Lonely Planet has found that traditional project planning has not worked:

techniques such as Gantt charts, cost/benefit analysis and related traditional approaches just stymie creativity, and do not bring ideas to fruition. So Lonely Planet now uses agile methods of product development which are live, dynamic and collaborative. All ideas are tested and evaluated across the pillars of Lonely Planet's strategy.

Ideas which are then candidates for development are then classified according to whether they are high or low in value, and effort: clearly Lonely Planet is looking to develop high value and low effort projects.

Lonely Planet does extensive field testing of its new ideas: 3500 people worldwide are given the ideas and their views and reactions are collected and analysed. Local focus groups are used too. Extensive use of video technology is made, known as observational research, in which video is taken of prototype users and analysed to refine product and service experiences.

The crux of success is what happens between idea generation and full –blown project development and management: this is the critical stage where getting it right makes a key difference to the future of the company.

As an example, in 2004, the print product (principally books and magazines) was scattered, so it was centralised in order to better organise and control it. Operations in London, USA, France and Australia were all consolidated to Melbourne. Then the company started to standardise the processes of New Product Development (NPD). The company achieved a decrease in new product development cycle time from 12 months to 3, using the agile system! 'Handoffs' that are inefficient were reduced, fixed or eliminated. Teams were face-to-face, speed and dynamism was achieved. It beats the waterfall/Gantt chart mechanism of organising product development according to Lonely Planet.

This dynamic/agile process of NPD was refined via a series of loops, first in the creation of new regional guide books, in which the development cycle time was reduced from 12 months to 3. The method was then refined and re-applied to the renewal process of a series of 'Discover' guides. In the third iteration, new country guides were developed using this system, with even more effectiveness and success, in which Lonely Planet brought more process controls into play, even in the early steps of NPD.

Lonely Planet is wedded to and gets great benefit from using teams which wideiy represent different functions in the organisation, to work on these NPD projects. These cross functional teams bring people together from all key functions:

- Logistics
- Layout
- Cartography
- Editing

- Project management
- Printing
- Marketing
- Production
- Finance
- Sales

This cross functional team approach leads to faster innovations and more effective outcomes.

In the most recent iteration of NPD, which is a new series of country guides, which comprise 60% of Lonely Planet sales revenue, the process has been further refined. The inspiration, an online forum over a 3-week period, was used to crash the product development cycle time and make it both more efficient and effective.

Lonely Planet domain of products and innovation

Lonely Planet organises its products and services around the 'travel cycle', which it defines in steps in a cycle:

- inspiration
- planning
- on the road
- reminiscing

New services are being developed across all the above steps, using new technologies such as smart-phones etc.

Gus and Lonely Planet have ramped up their innovation efforts as they refine their product development methodology. In the latest iteration of this, country books, they included an online forum as part of the hack days and development process. They achieved 200 ideas from this forum, which represents a real and powerful step to "bring the voice of the customer" into the innovation process. Lonely Planet also uses outside experts to complement its staff idea contributions and lead users, which is their way of implementing open innovation. This process has worked well enough so as to encourage Lonely Planet to drive it harder, faster and further in its development through each of its major iterations of new product development. The company has taken a decision to use a similar method to consider a whole of business transformation, in a sense meaning that this home-grown generic innovation methodology will and can be applied to the Lonely Planet business model and structure itself.

The current and next generation of innovation is to re-examine the way that product development occurs: it is currently a traditional process of book development, reflecting the company's history and roots.

"We go to all new media, attached to our traditional 'main machine' of book development and production, and it doesn't always work as effectively and quickly as we would like" (Gus Balbontin).

How Lonely Planet goes about developing new internet based services is currently adapted from how it develops new books, and Gus has recognised that there must be a better way, and is using the innovation process to seize this opportunity to improve.

The new approach is to transform from a quite linear process in the development of books and related products, to a whole-of-company system of 'content in' using the company content management system (CMS), which is to be separated from deployment of that content. Lonely Planet has some 80 authors regularly contributing written content along with images, video and other forms of content coming in. On the output side, there is a constantly developing set of forms of products and services, from books to E-books, TV products, internet services and mobile phone content etc. The aim is to reorganise the content in process into a hub from which products and services can draw material. A necessary prerequisite for effective deployment of this new approach is that the agility of the company and its products is not lost, but is enhanced. The aim is to make this new approach and system a company wide approach, rather than have a number of approaches that develop at the margin and are somewhat ad hoc.

Lonely Planet Strategy

Lonely Planet is positioned as an 'edgier' style of product than other travel information sources. It is more adventurous in both the items that it covers and describes, and in its style. Its books even include occasional swear words, when they are determined to be suitably descriptive, which would not be found in traditional books such as Frommers. Lonely Planet guides are more 'intimate' than others, more informative and more like a 'Bible of travel', according to market research. Lonely Planet has not been as successful in the USA than in other regions, perhaps because of the more conservative approach taken in markets and by consumers there. A question facing Lonely Planet is whether it can customise its products to different tastes, which it expects will be technically possible in the very near future.

Lonely Planet has been the first in its industry to move into mobile phone applications and TV products. It also distinguishes itself by not accepting advertisements in its books, whereas its competitors do so. Lonely Planet remains an independent voice from travel suppliers.

The new ownership of the parent company BBC has brought some changes, for example TV expertise and networking capability and a change in style to the 'edgier style'.

The 'edginess' is highly descriptive and differentiates Lonely Planet

NOTES

products from its competitors, appealing to the roots of market segments from where the company originated.

"We are fearless about telling it as it is" (Gus Balbontin)

In terms of positioning in its markets, the company has established a very loyal core of followers, whom they call 'world adventurers'. These customers comprise about 10% of the Lonely Planet market, and are the leading edge of consumers. They are "Lonely Planet travellers", loyal to Lonely Planet and they write back to Lonely Planet, providing valuable information which is captured by the company for future use. Many of these are long term customers, supporters of the company of some 30 years.

Lonely Planet is clearly much more than a travel book company these days. Its 'Thorntree' online forum has some 500,000 users including its world adventurers.

While the brand of this company is very powerful, and widely known globally, the fast moving innovation-based competitiveness and strategies of the company have hardly been publicised. Lonely Planet has been a quiet achiever until recently. The new ownership and CEO of the company are changing this slowly, using the brand more effectively and focussing on transforming the company via a series of large and small innovations. Hence innovation strategy and implementation effectiveness are core and critical to its future success and growth.

In the past, failure was a problem, as it traditionally is in the conservative book publishing industry. With the new system of hack days, fast prototypes and connected process steps, failure is significantly cheaper and is detected earlier, hence it is more easily accepted and experimentation is further fostered. The attitude to risk and potential project failures also starts with the type of people who are recruited and the culture that is fostered. Whereas the people used to be primarily from publishing with a perfectionist attitude, there is now more of a new economy approach, where it is accepted that speed is important and that not everything will work, and particularly not work perfectly. Lonely Planet's CEO uses the phrase "ruthless experimentation".

Lonely Planet abandoned the traditional pipeline and funnel on innovations: it failed them. Instead, the company now carefully controls the new ideas process, screening them, giving people 3–4 weeks to propose ideas, and through the hack days, and other methods, taking the best ideas forward. The company has found that extroverted people are well suited to the open collaborative approach of the intensive hack days, but it does not suit everyone. More introverted people are still able to contribute their ideas on innovations and the development of new ideas through an online process.

Lonely Planet is committed to using its innovation resources in a focussed manner. Gus Balbontin tries very hard not to 'wound' ideas at any stage, either they are promoted and encouraged through the processes or they are fully killed

off. Wounded ideas 'fester' and are unproductive. Lonely Planet has found that this disciplined approach is highly effective. The culture of Lonely Planet is still not fully into the 'new economy' mode and has its roots back in publishing. There are still perfectionists, and some who are not fully involved in the fast prototyping, and further cultural change is on the agenda. While the process of experimentation allows Lonely Planet to further develop its products and processes, there is room to further integrate the 'new stream' of the company with the 'main stream'.

In making clear decisions about which ideas go forward and which are killed off, Lonely Planet starts with the strategy filter. This means directly passing the test of whether the new idea fits with the business strategy and direction. There is then a series of testing challenges conducted by panels and focus groups. This is followed by prioritisation sessions with Lonely Planet executives, where formal 'kill' or 'go forward' decisions are made and resources are allocated.

There is no fixed budget for innovative activities and product development. Decisions are made regarding resources, in real time, as the company remains committed to a high level of agility. There is no formal plan of engagement in innovation terms.

Lonely Planet practices innovation partly through collaboration with other organisations. Examples are an open relationship with a partner company, O'Reilly Media. Gus Balbontin has exchanged information with many other players in this space around the world and has been on extensive study tours to exchange this information first hand. These study tours of visiting like minded companies globally has been extremely valuable in keeping Gus and Lonely Planet thinking and working on innovations at the edge of the fast moving world of electronic and digital media.

Measurement

Lonely Planet has not instituted formal measures of innovation. It does keep tabs on its success and failures as projects, such as recalling that CMS (customer management systems) failed twice before lessons learned were used to get it right the third time. It is however, working in an intuitive, organic manner. The Lonely Planet style and size is such that KPIs are not necessary at this point. Gus is not committed to increasing the degree of formality at this point or in the foreseeable future, wanting to keep the agility strong as a first priority over formality. However the innovation outcomes and returns on investment are closely monitored by the global leadership Team of Lonely Planet and the Board, which shows strong interest in innovation and its deliverables.

As to resources for making such innovations happen, Gus does not have any of his own staff, but, with no direct reports and full time staff, is considered and works as the catalyst of many other staff who have mainstream full time jobs, and

also contribute in a significant way to the Lonely Planet new stream via projects. The company runs virtual teams and hack days that drive projects. An example is a group of 10 people, highly cross functional as a team, in a 6-month project.

Lonely Planet has not had a culture in the past of paying for performance. There is a new bonus system coming in with the new leadership and ownership. Active performance rating is also a relatively newly applied concept in Lonely Planet. Recognition systems have been active more for managers, and have not yet got to the 'shop floor', such as a line cartographer. There is little formal recognition of contributions of innovative activities that are explicit, as Gus is trying to foster high levels of innovation in a 'guerrilla' manner: doing innovation but not calling it innovation. Gus reports to two members of the group leadership team, who are direct reports of the CEO. As global innovation manager, Gus is part of a 25 person senior leadership team, one level below the 6 person group leadership team. It is at the senior leadership team level that Gus is trying to embed innovation.

Lonely Planet is making sustainable development a part of its activities and is active. The link between sustainable development and main stream of innovation is limited to date, however the company is proactive on environmental management, especially in its printed products division. In terms of social contributions, the Lonely Planet culture fits this approach, and there are numerous activities going on, including the Lonely Planet Foundation in Cambodia and the Planet Wheeler Foundation run by the company founders.

Within Lonely Planet there are still some recognised 'bumps', along the road to world class innovation practices. Whereas the innovation style is fast and agile, the finance department still requires the traditional business cases and budgets, which is understandable but causes some complexity of objectives. The underlying industry culture is perfectionist and hence quite careful and slow to move. Editors who are an important step in product development steps are from this publishing background and bring this traditional view of getting the material and the product fully right before release, even if it takes months.

Lonely Planet would like to be able to draw on a stronger innovation culture generally in Australia, where innovation success is strongly celebrated. Australia has nothing similar, even on a smaller scale to the overseas TED conference. Further open innovation is constrained by a great deal of legal matters, such as copyright, NDAs and bureaucracy, which while necessary, do add to the friction of getting innovation done quickly and effectively. Gus believes that just as iTunes has 'transformed and done' the music industry, there are 'clunky' aspects of legal frameworks which lag well behind the needs of E businesses and the Twitter generation. Lonely Planet purposely does not work too diligently on IP protection, preferring to be a fast mover. It holds no patents, but of course does hold copyrights, although it knows that these are widely infringed upon in parts

of Asia, through illegal copying and printing of its books: an irritant which it tolerates. Intellectual Property has not been a formal concern because the strong brand of Lonely Planet is assumed to 'carry us through'. In respect of keeping its knowledge contained, and well managed, the method is mostly organic and informal. The balance that is pursued is between incremental innovation and radical changes, supported by knowledge. Lonely Planet believes that it does a fine job of knowledge management in its products for its customers, but has room for improvement in its internal knowledge management processes and outcomes. It is clear, however that the 550 staff at Lonely Planet, the 220 freelance authors and the millions of customers in both the old economy and particularly the new economy services provided by Lonely Planet, are in for a time of great change, fast servicing of their needs, and dynamically developing new ways of creating, processing and accessing knowledge about the world.

Source: *http://www.innovation.gov.au/Industry/IndustryInnovationCouncils/Documents/InnovationforbusinesssuccessTechstrat.pdf*

5.9 SUMMARY

- Intellectual property is that property which results from the intellectual efforts of individuals or organisations, in other words such property is the creation of the human mind and human intellect.
- A Patent is a legally protected property right that confers on its holder the exclusive right in the invention for a limited period.
- Role of IPR lay in providing a legal right to the inventor to protect his/her creation as well as preventing others from illegally exploiting the creation and thus avoid re-invention of the wheel.
- The kinds of work covered by copyright include literary works, such as novels, poems, plays, reference works, newspapers, computer programs, databases, films, musical compositions and choreography, artistic works such as paintings, drawings, photographs and sculpture, architectural works, advertisements, maps and technical drawings.
- A Trade Mark is a visual system in the form of a word, a device or a label-applied to an article of manufacture or sale with a view to indicate to the consumer about (lie origin of manufacture of goods, affixed with that mark.
- A license is a contract which awards to a party other than the owner of the intellectual property the right to make, use, sell or import products or services based on the owner's intellectual property.
- The DSS involved a combined approach developed for analyzing portfolios of technology investments, multi-criteria decision analysis, Monte Carlo simulation, and mathematical programming techniques were used to enumerate

NOTES

every possible technology portfolio combination to identify high science-value missions and technologies that could be funded within a specified budget.

- Product innovation involves coming up with something new (or sufficiently different).
- If service innovations come second behind product innovations, then process innovations almost certainly come a poor third.
- Reverse Engineering (RE) is the decompilation of any application, regardless of the programming language that was used to create it, so that one can acquire its source code or any part of it.
- The issue of Intellectual Property Rights was brought on an international platform of negotiation by World Trade Organization (WTO) through its Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS).

5.10 KEY TERMS

- **Intellectual property:** Intellectual property is that property which results from the intellectual efforts of individuals or organisations, in other words such property is the creation of the human mind and human intellect.
- **Patent:** Patent is an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem.
- **Copyright:** Copyright is a legal term describing rights given to creators for their literary and artistic works.
- **Trade Mark:** Trade Mark is a visual system in the form of a word, a device or a label-applied to an article of manufacture or sale with a view to indicate to the consumer about (lie origin of manufacture of goods, affixed with that mark.
- **License:** License is a contract which awards to a party other than the owner of the intellectual property the right to make, use, sell or import products or services based on the owner's intellectual property.
- **Reverse Engineering (RE):** Reverse engineering is the recompilation of any application, regardless of the programming language that was used to create it, so that one can acquire its source code or any part of it.

5.11 ANSWERS TO 'CHECK YOUR PROGRESS'

1. patent
2. Copyright
3. trademark

4. Product
5. Reverse Engineering (RE)
6. General Agreement on Tariff and Trade

5.12 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a note on patenting inventions and innovations.
2. Discuss the role of patents, copy right, trade marks and license in innovation and R&D.
3. Define Intellectual Property Rights.
4. Write a short note on Decision Support System in R&D.

Long-Answer Questions

1. Make a comparison between product and process innovation.
2. Define Reverse Engineering (RE).
3. Discuss the laws regarding the protection of innovation.

NOTES

UNIT 6 CORPORATE AND GOVERNMENT COMMITMENT TO INNOVATION AND R&D

Structure

6.0 INTRODUCTION

Corporate function of R&D is a component of management of technology and innovation. It is essentially a strategic/functions for it attempts to achieve optimal positioning of the organization in your competitive environment on strength, of technology. It is a managerial, rather than technical function. It involves the entire organization and its elements are built into each and every management function.

Management of technology and innovation is a relatively new concept. It has begun to find applications in India and is expected to rapidly occupy a dominant role. In industrially developed countries, it began to attract serious attention in 1960-70, and has since then undergone a few incarnations.

The objective of this unit is to discuss and explain the strategic role of corporate function and government to R&D and innovation.

6.1 UNIT OBJECTIVES

After going through this unit, you will be able to:
- Explain R & D as a corporate function
- Discuss partnership in innovation
- Define global innovation index.

6.2 R&D AS A CORPORATE FUNCTION

The objective of corporate function of Research and Development (R&D) is to provide strategic managerial inputs to strengthen the process of technology development, innovation and entrepreneurship in an organisation. The question that follows is how is that achieved? Every organisation develops kind employs methods suited to its management style and needs. Also, there can be no exhaustive list. The following are the four basics ones:
- Culture
- Organisational design
- Technology base
- Core competence

A typical strategic management process leads to development of strategic plans for the entire business of an organisation. Such a plan is referred to-as "Grand Strategy'. It is a comprehensive plan outlining major actions through which the organisation intends to achieve its objectives in dynamic environment. Besides Grand Strategy', strategic management process also- develops plans for each function which are known its Functional Strategies. The process of strategic planning which leads to development of these 'strategies' is both interactive and iterative; interactive because it stimulates creative and Knowledgeable people involved in the process to participate and contribute, iterative (meaning; repetitive) because decisions are taken after trial and error. Process of strategic planning relies on inputs from individuals, functions, business, environment and experiences. The plan that then emerges is result of the net and not aggregate influence of these inputs.

6.3 IN HOUSE R&D RESOURCES AND COMMITMENT

The resources in the corporate sector, men and material, and money are allocated for various projects in such a manner that overall profitability of the business is increased. The Board of Directors of a company should provide clear directions of the R&D department on the following points:

1. Requirements for the types of new products.
2. Targeted new markets.

3. Technology option for the company.
4. The products and processes which are not to be developed further.
5. The rate of expansion for each area of business.

The question is how much a company should spend on R&D is rather like that of how much a man should spend on buying a home. The mechanism of the provision of funds to the R&D lab depends upon the adoption of the technical policy by the corporate sector. There are many possible methods for undertaking such exercise. For example, one way is to allocate a fixed sum as functional budget, every year and the other way is to allocate a fixed percentage of profit for carrying out the assigned tasks in a R&D project. Each system has its merits and de-merits. For example, in India, industry devotes 6% of its sales turn-over to R&D programmes. In the advanced countries, the corporate sector contributes 50-80% of its share to the total F&D expenditure.

There is a scheme under which well operated in-house R&D units of industry are granted recognition by the Government (i.e. DSIR). Today there are around 1250 in-house R&D units recognised by lire Government. They are in various sectors such as Chemical and allied areas, drugs, petrochemicals, electrical and electronics, mechanical engineering, cement, textile, agro-industries and others. These are distributed throughout the country. They undertake research mainly relating to the areas of operation of the company on product and process development and improvement, technology absorption, etc. Some of the very innovative technologies have been developed and successfully commercialized by the in-house R&D units.

6.4 PARTNERSHIP IN INNOVATION

It is a well known fact that during the last decade, due to the tremendous progress made in information technology, the entire world has become one global village. Partnerships are being entered into not only for marketing but also for manufacture and licensing, of new innovations. The latest trend of this globalisation is partnerships in R&D innovations. For instance, in the area of computer software, the basic design of the software including the source code may be carried out in one company in the USA. passed on to another Indian software design company by say 5 pm in the evening through satellite links, and the software package is completed by the Indian company tested for any bugs and passed back with the agencies or scientists who are physically present in such locations. For example, high altitude equipment, medicines for high altitude sickness, clothing for sub-zero temperatures can be tested by agencies operating in Siachin/Antartica. New types of designs of earthquake buildings have to be finally proven on the ground in places like Kohima. To develop a new-process for extracting tin from nodules which are available only in the high seas at depths of around 10,000 mtrs below the sea level, require partnerships with the agencies such as the National Institute of Oceanography (NIO), Goa who can

collect such nodules. In fact, the development of equipment to collect, such nodules by itself requires very high technological inputs.

Essential Requirements for Partnership in Innovation

Partnership is basically an agreement or understanding. The relationship between partners is of crucial importance. The essence of the relationship in technology development between two or more partners is that there is a give and take attitude with the common objective of a win-win situation for all the partners involved in the task. This is particularly so in the case of partnerships in innovation and technology development where it many not be very easy to clearly identify and define the role and task of the participating agencies. What is more all the partners have to realise and appreciate the risks involved in technology development and understand that when they enter into unchartered waters many obstacles may arise which even the best scientific brains could not have anticipated at the time when they entered into partnerships.

The commercial world however, always is looking for "what is in it for me" syndrome. Therefore, it is very important to understand the varying perceptions of the benefits that may accrue and the problems (losses) that they may have to face in the technology development and commercialization task. While a lot depends on the type of partners involved, there are certain basic concepts that must not be overlooked.

Knowledge Facts

It is important that all the partners are provided the basic factual information relating to the invention/innovation such as the background of the scientists, the status of the development, pitfalls if any. Many partnerships run into difficulty because the facts have not been placed on the table. During the discussions between the partners many questions are asked for eliciting information from one another. While sometimes the full information desired by a partner may not be available, it is important to know the reasons as to why such information is required by that partner, as this throws some light on how important that information is for that partner to perform the tasks entrusted to him.

Good Communication and Negotiating Skills

Everyone knows that a good personal relationship is the key pre-requisite to good communication. Communication has two modes-listening and speaking and both are equally important. Unfortunately, scientists are good speakers but poor listeners. One technique successfully employed for "Active Listening" is to take notes while the other person is speaking. Note taking achieves two goals. It forces you to pay attention and it shows the other side that you are listening. Like note taking, the habit of asking questions helps you to listen closely and it tells the other side that you are listening with interest. It also provides a referential basis for sorting out problems that may be come up, at a later stage.

Negotiation skills play an important role in the materialisation of innovation partnerships. The skills can be acquired through education and training. One important aspect is to have a positive attitude which includes:

- Avoiding annoying behavior
- Understanding cultural differences
- Paying attention to body language
- Avoiding rigid standoffs

6.5 FINANCERS OF R&D PROJECTS

Finance is the ultimate key factor which is required for converting an invention into a successful commercial production. Since many inventions will eventually prove to be commercially viable, the technology development funding, agencies play quite a different role as compared to the normal banks. There are many technology development funding agencies in the country and they have a variety of schemes to cover different types of projects. Most of the schemes operate on the principles of partnership. Thus the Technology Development Board (TDB), NRDC, Venture Capital Fund of IDBI, Risk Capital and Technology Finance Corporation (RCTC) can provide financial assistance by way of equity participation i.e. they become joint legal owners of the new company established for the commercialization of an invention. The equity may, of course, be disinvested at a later stage preferably to the promoters but at the market value. The concept is that the funding Agencies share in the profits of the enterprise by way of dividends and also reap the benefits of share (stocks) appreciation. International experience indicates that venture Capitals make 4-10 times of the money that they have invested from the successful ventures. This covers not only the losses that they may incur from the ventures that fail but also leave a significant profit for themselves.

The following are the key financing agencies and their functioning:

Scheme of Technology Finance and Development of RCTC

Risk Capital & Technology Finance Corporation Ltd. (RCTC), a public limited company incorporated with effect from 12th January, 1988 is the successor to the erstwhile Risk Capital Foundation (RCF), which had been sponsored by IFCI in 1975. It has been providing:

(i) Risk capital to first generation entrepreneurs intending to set up industrial projects in the medium and medium large, sectors within a project cost range of Rs. 2 crores to Rs. 10 crores, and

(ii) finance for technology development particularly for advancement of research and development.

It is significant that 60% of the cases assisted by RCTC involved technologies developed by the entrepreneurs themselves.

RCTC has been depending on funds support being provided by IFCI by way of subscription to its share capital and interest free loans. RCTC has so far given assistance in individual projects only up to Rs. 2 crores in view of its limited resources. To strengthen RCTC's resources to enable it to handle large number and larger size of projects as also to extend its ambit to cover a wide range of eligible organisations, a venture capital fund has been floated by UTI and IFCI which would be managed by RCTC. The venture capital fund called "VECAUS III" has a capital base' of ₹ 30 crores.

Venture Capital Fund of IDBI

The VCF of IDBI is designed to promote adoption of domestic technology and encourage the adaptation of imported technology. It covers the setting up of pilot demonstration plants, development of products or processes which substitute for imports or lead to quality upgradation reduce material consumption, energy savings etc. It also covers the cost of surveys, seed marketing, market promotion and related training.

The assistance is by way of conventional loans. The amount ranges between ₹ 5 lakhs to ₹. 250 lakhs for each project. The promoters are required to contribute 10% for projects costing up to ₹ 50 lakhs and 15% for ventures costing more than ₹ 50 lakhs. The assistance is available at a concessional rate of 6% p.a. during the development period which can be enhanced to 17% p.a. once the product/process is developed and available to commence commercial production. The interest rate may be restricted to 14% p.a. with a charge on sales also.

Venture Capital Scheme of TDICI

After IFCI, ICICI is one of the first institutions in the country' to initiate venture capital operations. The activity was commenced in 1986, and was later transferred by ICICI to a company created for the purpose called Technology Development & Investment Company of India (TDICI) at Bangalore. Under the scheme, TDICI extends financial assistance to projects involving commercialisation of new technology for which, due to inherent risk, the promoters may find it difficult to raise funds from traditional sources through conventional financial mechanisms.

Activities eligible

TDICI assistance is available to projects undertaking the following activities:

(i) commercial R&D involving development of new technology or an innovative product

(ii) implementation of an indigenously developed technology on a commercial scale

(iii) implementation of an innovative technology imported transferred from an external source

Under its scheme, TDICI also provides assistance for projects which may not involve any indigenous technology development but are based on imported technology; it may be noted that VCF of IDBI and RCTC emphasise indigenous technology development.

PACT (Programme for Advancement of Commercial Technology) Scheme of ICTCT

PACT scheme envisages technology development (and not technology transfer) through Indo-US joint ventures in R&D. It is expected that such joint ventures will result not only in development of new technologies, but also provide Indian partner an opportunity to acquire the R&D management techniques from USA. PACT cofinance pre-production R&D costs of innovative products and processes.

To be eligible for PACT support, a project should

(i) involve the development through R&D efforts, of an innovative product or process which promises tangible benefits to the Indian economy:

(ii) be proposed by an Indian company and US company as a team, with each member having a specified role in the development and commercialisation programmes;

(iii) have potential for commercialisation in three years;

(iv) involve project cost, typically not exceeding US $ 1 million and envisage a PACT contribution up to US $ 500,000;

(v) involve technology development and not just technology transfer; and

(vi) not be related to defense/armament surveillance, weather modification abortion-related equipment or services.

The cost of eligible projects should not exceed US $ 1 million and should envisage a PACT contribution up to US S 500,000. The promoters' contribution is normally 50% of the cost of the project. The scheme is not a true Venture Capital Scheme.

Check Your Progress

Fill in the Blanks:

1. Process of .... relies on inputs from individuals, functions, business, environment and experiences.
2. ....is basically an agreement or understanding.
3. The VCF of .... is designed to promote adoption of domestic technology and encourage the adaptation of imported technology.

Risk Finance by National Research Development Corporation (NRDC)

National Research Development Corporation (NRDC), New Delhi, a Government of India enterprise in the Department of Scientific and Industrial Research (DSIR), is charged with the objective of commercialising research carried out in national laboratories. It provides risk finance for technology development both by way of equity participation in companies set up for the first commercialisation of NRDC know-how and also provides development loans for setting up of pilot plants. NRDC s participation in equity capital is limited to companies set up specifically for commercialising NRDC know-how having total capital investment of the order of ₹ 50 lakhs or more, restricted to the first commercial plant based on the technology given by NRDC. NRDC is prepared to share in risks by writing off a part or the whole of the development loan if the project is unsuccessful. NRDC acquires technologies

from indigenous sources including national relations for transfer to companies as a package.

6.6 ROLE OF CONSULTANTS IN R&D

Consultants play a significant role in industrial development, particularly in R&D and technology innovation, with the help of their specialized knowledge. They help along the innovation process from conceptualization to innovation and further to marketing new products and processes.

Consultancy is essentially a knowledge-based profession and consultants are often termed as carriers of technology and related services. While a wag once defined a consultant as a person who borrows your watch and tells you the time, what this really signified was that a consultant adds value through knowledge. A consultant mostly uses existing knowledge acquired through his professional experience over a period of time. However, some large consultancies and individual professionals do have their own R&D facilities to develop new technologies, mostly in industrially advanced countries.

An engineering company with multi-disciplinary expertise and approach can provide the necessary support to convert the know-how developed at laboratory/ bench scale in national research institutions to a commercial size, One has to appreciate that the global nature of the competition and the range of expertise now required to develop a sped fie technology makes it imperative to have R&D collaboration at all levels including consultants. The involvement of an engineering company with R&D for process development has been successful in a number of cases. Engineers India Limited has been involved in the development of a number of processes in association with national research institutions, and its own in-house R&D supplemented by necessary inputs from various disciplines in the company. The development of process design capabilities and successful commercialisation of processes for the manufacture of Aromatics based on Sulfolance, Food Grade Hexane and Acrylates are examples of this collaboration. Capabilities have been developed to offer complete process design for semi Regenerative Reforming in collaboration with Indian Institute of Petroleum and IPCL, A host of refiner)' technologies have also been developed in this manner. The in-house development in EIL and RAGE, software for data reconciliation and Gamma Scanning Capabilities for diagnostic studies of flow inside equipment illustrate how a technical consultant can address R&D needs for real time feedback of accurate plant data.

A consultant can play an Advisory role and also an active role with R&D. Academicians and scientists may not necessarily perceive R&D needs which are relevant to ground realities of our country. The right type of consultants can help in policy making process and selection of R&D projects. The active role would involve collaborative efforts between the R&D institutions, industry and consultants, Humphreys and Glasgow have participated with CSIR labs where technical expertise

of the company has worked and to hand to develop processes and technologies for commercialisation. The caution to be exercised here is to make sure that such projects are selected judiciously, avoiding instances of "re-inventing the wheel" or of purely academic endeavours. A sense of accountability and productivity in laboratories is also introduced.

The role of technical consultants in management of creativity and R&D has been emphasized in commercial R&D companies". While it has been recognised that creativity is the greatest motivating factor for the industry managers, what motivates the R&D people is a role in the industrial application. There is an urgent need for management and marketing of their creativity leading to commercial exploitation. Therefore, bridging these two groups requires a special breed of people who understand and interact in both languages i.e. from eddy current loss to internal rate of return (IRR).

An independent consultant provides advisory services to his clients towards finding solutions to the problems related to his field of operations. Thus, a consultant is expected to be equipped with technical and managerial knowledge and expertise; market information including requirement of industry and project authorities; and sources of technologies and of technical services. Consultancy services include market surveys, pre-feasibility reports, feasibility reports, project reports, design and engineering, up scaling to new technologies and pilot trials, sourcing and acquiring technologies, making technology transfer agreements, training personnel, laying out and operating plants, preparing drawings and technical specifications, sourcing and procuring equipment and machinery, costing products, arranging finance, directing marketing, and so on.

Successful research and development (R&D) and innovation involve conceptualization of an idea, to making and marketing a product or process through various stages of development and innovation. Experience has shown that very few ideas really get successfully converted to profitable businesses. The success rate of R&D in industry is higher than in laboratories, because industrial R&D is predominantly market-driven and is often incremental in nature, while lab-scale R&D is more generic and fundamental in nature.

6.7 CREATING A PRODUCTIVE TEAM CULTURE

An important role of the manager of R&D is to stimulate the innovative thinking of the R&D personnel. The manager can stimulate people to take new looks at old technologies, find new application for them and make suitable innovations. An important activity in this regard is to adopt creative problem-solving methods such as synectics, brainstorming, morphological analysis, value engineering, etc. to stimulate people to generate creative solutions to identified problems or needs.

It is not enough only to stimulate creativity, it is equally necessary to test the personnel's ability to innovate. This can be done by allowing them to try to innovate which involve risks of resource allocation, and uncertainty of achieving results as the ability of a team or an individual is unknown till them.

Based on some of the important studies report the literature on these issues, Bowonder has summarized the following chain of activities that constitute the job profile of R&D managers with the ultimate objective of successful technology transfer and customer satisfaction;

- Setting of R&D activities
- Recruiting and organizing an R&D team
- Motivating the team
- Generating ideas
- Formulating projects
- Selecting projects
- Managing projects

6.8 GOVERNMENT SUPPORT FOR R&D INFRASTRUCTURES AND RESEARCHERS

There is need to make continuous efforts, on the part of both Central and State Governments, so as to develop and promote various innovations and technologies in India as well as to spread these to the worldwide markets. The Central authority responsible for this in India is the 'Ministry of Science and Technology'. The Department of Science and Technology (DST) and Department of Scientific and Industrial Research (DSIR) are its two nodal agencies which are responsible for promoting science and technology (S&T) activities in the country as well as for supporting inventors/ entrepreneurs in their pursuits. National Innovation Foundation (NIF) has also been established to encourage Indian innovators by providing them adequate institutional support.

These central agencies, along with efforts of States/ Union Territories, have been undertaking many policy initiatives and measures as well as announcing many schemes and programmes with a view to promote innovation and S&T in the country. Some of the prominent ones are:- Technology Promotion, Development and Utilization (TDPU) Programme; Technology Development and Innovation Programme (TDIP); Science and Technology (S&T) Policy; National Innovation Act, 2008; etc. All such incentives aim to accelerate economic growth of Indian economy and improve the standard of living of the people.

6.8.1 Policies and Procedures

Various policy measures and incentives have been undertaken, both at the Centre and the State levels, so as to promote science and technology infrastructure and

innovation activities in the country. One of the important step in this direction has been the announcement of Science and Technology (S&T) Policy, which seeks to reiterate India's commitment to participate as an equal and vigorous global player in generating and harnessing advances in science and technology for the benefit of all humankind. It mainly aims to promote and support innovation in all its aspects, and accordingly create a comprehensive national system of innovation covering science and technology as well as legal, financial and other related aspects.

The main objectives of the S&T policy are to:-

- Ensure that the message of science reaches every citizen of India, man and woman, young and old, so that they advance scientific temper, emerge as a progressive and enlightened society, and make it possible for all to participate fully in the development of science and technology and its application for human welfare. That is, science and technology is to be fully integrated with all spheres of national activity.
- Ensure food, agricultural, nutritional, environmental, water, health and energy security of the people on a sustainable basis.
- Mount a direct and sustained effort on the alleviation of poverty, enhancing livelihood security, removal of hunger and malnutrition, reduction of drudgery and regional imbalances, both rural and urban, and generation of employment, by using scientific and technological capabilities along with India's traditional knowledge pool. This will call for the generation and screening of all relevant technologies, their widespread dissemination through networking and support for the vast unorganized sector of economy.
- Vigorously foster scientific research in universities and other academic, scientific and engineering institutions; and attract the brightest young persons to careers in science and technology, by conveying a sense of excitement concerning the advancing frontiers, and by creating suitable employment opportunities for them. Also, to build and maintain centres of excellence, which will raise the level of work in selected areas to the highest international standards.
- Promote the empowerment of women in all science and technology activities and ensure their full and equal participation.
- Provide necessary autonomy and freedom of functioning for all academic and R&D institutions so that an ambience for truly creative work is encouraged, while ensuring at the same time that the science and technology enterprise in the country is fully committed to its social responsibilities and commitments.
- Use the full potential of modern science and technology to protect, preserve, evaluate, update, add value to, and utilize the extensive knowledge acquired over the long civilizational experience of India.
- Accomplish national strategic and security-related objectives, by using the latest advances in science and technology.
- Encourage research and innovation in areas of relevance for the economy and society, particularly by promoting close and productive interaction between

private and public institutions in science and technology. Sectors such as agriculture (particularly soil and water management, human and animal nutrition, fisheries), water, health, education, industry, energy including renewable energy, communication and transportation would be accorded highest priority. Key leverage technologies such as information technology, biotechnology and materials science and technology would be given special importance.

- Substantially strengthen enabling mechanisms that relate to technology development, evaluation, absorption and upgradation from concept to utilization.
- Establish an Intellectual Property Rights (IPR) regime which maximises the incentives for the generation and protection of intellectual property by all types of inventors. The regime would also provide a strong, supportive and comprehensive policy environment for speedy and effective domestic commercialisation of such inventions so as to be maximal in the public interest.
- Ensure, in an era in which information is key to the development of science and technology, that all efforts are made to have high-speed access to information, both in quality and quantity, at affordable costs; and also create digitised, valid and usable content of Indian origin.
- Encourage research and application for forecasting, prevention and mitigation of natural hazards, particularly, floods, cyclones, earthquakes, drought and landslides.
- Promote international science and technology cooperation towards achieving the goals of national development and security, and make it a key element of India's international relations.
- To integrate scientific knowledge with insights from other disciplines, as well as ensure fullest involvement of scientists and technologists in national governance so that the spirit and methods of scientific enquiry permeate deeply into all areas of public policy making.

Secondly, efforts are being made to draft new innovation law called 'National Innovation Act, 2008'. This Act applies to the whole of India. It aims to facilitate public, private or public-private partnership initiatives for building an Innovation support system to encourage innovation, evolve a National Integrated Science and Technology Plan as well as codify and consolidate the law of confidentiality in aid of protecting confidential Information, trade secrets and innovation. As per the Act, the term 'Innovation' means "a process for incremental or significant technical advance or change, which provides enhancement of measurable economic value, and shall include: (a) introducing new or improved goods or services; (b) implementing new or improved operational processes; and (c) implementing new or improved organizational / managerial processes. Wherein, measurable value enhancement or economic significance may include one or more of the following: (i) increase in market share; (ii) competitive advantage; (iii) improvement in the quality of products or services; (iv) reduction of costs".

As a result of all such measures, there is existence of sound infrastructural base for science and technology and solid foundation for innovation to prosper. These include well-equipped research laboratories, higher educational institutions and highly skilled human resources. India's strength in basic research/ S&T is recognized internationally and covers an impressive range of diverse disciplines, areas of competence and of applications. Successes in agriculture, health care, chemicals and pharmaceuticals, nuclear energy, astronomy and astrophysics, space technology and applications, defense research, biotechnology, electronics, information technology and oceanography are widely acknowledged.

6.8.2 Schemes and Incentives

There are several schemes and incentives undertaken, from time to time, by the Ministry of Science and Technology, the central level authority as well as by the State Governments. These schemes largely aim to build strong science and technology infrastructure in the country, which can further the process of innovation, promote technology commercialization and thus, can help to raise socio-economic conditions of the people.

One of the main initiatives taken in this direction is the launch of Technology Promotion, Development and Utilization (TDPU) Programme which is aimed at promoting technology development and industrial research in the country as well as encouraging its utilization by various section of economy, be it industry, academic, scientific institution and the society at large. The programmes and activities under this scheme are centered around promoting industrial R&D; development and commercialization of technologies; acquisition, management and export of technologies; promotion of consultancy capabilities; etc.

Under TDPU Programme, there is one very important programme component called "Technology Development and Innovation Programme (TDIP)", which aims to develop technologies and promote innovation in the country. TDIP is sub-divided into 2 programmes, namely:-

1. **Technology Development and Demonstration Program (TDDP)** - It was earlier known as 'Programme Aimed at Technological Self-reliance (PATSER)'. It is a plan scheme of Department of Scientific and Industrial Research (DSIR) to promote industry's efforts in development and demonstration of indigenous technologies, development of capital goods and absorption of imported technologies. That is, its broad objectives for achieving self-sufficiency in industrial growth are:-

- Supporting industry for technology absorption, development and demonstration.
- Building indigenous capabilities for development and commercialisation of contemporary products and process of high impact.
- Involvement of national research organisations in joint projects with industry.
- Technology evaluation in selected sectors.

To achieve such objectives, DSIR provides on a selective basis partial financial support to research, development, design and engineering (RDDE) projects proposed by industry in the following areas:

- Development and Demonstration of new or improved product and process technologies including those for specialized capital goods, for both domestic and export markets.
- Absorption and upgradation of imported technology.

The partial financial support by DSIR is primarily meant for covering expenditure involved in prototype development and pilot plant work, test and evaluation of products flowing from such R&D, user trials, etc. Bulks of costs of the project are from the industry's resources.

In general, following types of proposals for RDDE projects are considered for partial financial support:

- Projects undertaken solely by in-house R&D units of industrial firms.
- Projects undertaken jointly by Industry and National R&D Organisations and Institutions.
- Collaborative projects of common interest to the concerned sector/area, proposed by a group of industries/users, national research organisations, etc.
- Projects may cover products and processes in various important industries such as metallurgy, electrical, electronics, instrumentation, mechanical engineering, earth moving and industrial machinery, chemicals & explosives, etc.

2. **Technopreneur Promotion Programme (TePP)** was launched to tap the vast innovative potential of the citizen of India. TePP is a mechanism to promote individual innovators to become technology-based entrepreneurs (Technopreneurs). Thus, its main objectives are to:-

- Promote and support untapped creativity of individual innovators.
- Assist the individual innovators to become technology based entrepreneurs.
- Assist the technopreneur in networking and forge linkages with other constituents of the innovation chain for commercialization of their developments.

The activities under TePP include providing financial support to selected and screened individual innovators having original ideas for converting them into working models, prototypes and so on. TePP assistance is provided to the innovator to meet expenditure on the following:

- R&D/Engineering consultancy
- Procure small equipment, tools etc. required
- Raw Material/ Accessories (for prototype/process trials),
- Fabrication cost (for prototypes)
- Patent guidance and support
- Manpower
- Testing & Trials
- Any other relevant costs

TePP support to the innovators is limited to 90% of the total cost of the project and remaining 10% is to be borne by the innovator/inventor.

Further, 'Innovation of Science Pursuit for Inspire Research (INSPIRE)' is another such innovative programs proposed by the Department of Science and Technology for attraction of talent to science. The basic objective of INSPIRE would be to communicate to the youth population of the country the excitements of creative pursuit of science and attract talent to the study of science at an early stage and build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base. INSPIRE Scheme has included three components. They are: (i) Scheme for Early Attraction of Talents for Science (SEATS); (ii) Scholarship for Higher Education (SHE); and (iii) Assured Opportunity for Research Careers (AORC).

6.9 ROLE OF DST, DBT AND CSIR

Several Government Departments have been undertaking programmes involving direct funding of R&D projects in industry. The given below are the key departments like DST, DBT and CSIR and role played in industry growth:

6.9.1 Department of Science and Technology (DST)

The Department of Science and Technology (DST) is funding several industrial R&D programmes such as Drugs and Pharmaceuticals Research Programme, Instrument Development Programme and Advanced Materials Development Programme. The basic objectives of the programme on 'Drugs and Pharmaceuticals are:

- synergise the strengths of publicly funded R&D institutions and Indian pharmaceutical industry;
- create an enabling infrastructure, mechanisms and linkage to facilitate new drug development;
- stimulate skill development of human resources in R&D for drugs and pharmaceuticals: and
- enhance the nation's self reliance in drugs and pharmaceuticals especially in areas critical to national health) requirements

The programme supports selectively collaborative projects between an industry and a publicly funded research institute / university. The collaboration should ideally be at all levels such as scientific, technical and financial wherein the financial contribution of the publicly funded R&D would normally be met by DST.

The programme supports drug development for all types of medicinal systems including the traditional Indian medicinal system and the modem one.

Under the 'Instrument Development Programme' projects on design and development of instruments or upgradation of the technology are considered. Grant-in-aid is given to R&D institutions including Universities, IITs etc.

Projects proposals are invited for development of instruments/sensors in the following areas:

- Analytical instruments
- Environment monitoring and pollution control instruments
- Laser based instruments
- Instruments for food processing
- Medical instruments
- Test and measuring instruments
- Geo-scientific instruments
- Agri-electronic instruments
- Sensors
- Textile instruments

6.9.2 Department of Bio-Technology (DBT)

The Department of Bio-Technology (DBT) has been promoting and financing various aspects of a R&D in relation to Bio-technology undertaken by several agencies including industry. The main thrust areas of DBT support are Human Resource Development (HRD), Bio-technology R&D and Infrastructure Development. The DBT through its several Task Forces has been supporting industry-oriented R&D projects.

6.9.3 DSIR (The Department of Scientific and Industrial Research)

The Department of Scientific and Industrial research (DSIR) played a significant role in R&D and innovation under its Programme Aimed at Technological Self Reliance (PATSER). It provides financially supports in research, development, design and engineering projects. The basic objectives of the PATSER Scheme are:

- Supporting Industry for technology absorption, development and demonstration
- Building indigenous capabilities for development and commercialization of contemporary products and process of high impact
- Involvement of national research organisations in joint projects with industry

Towards achieving the above objectives the department provides support on a selective basis. The partial financial support to research, development, design, engineering, (RDDE) projects to be proposed by Industry in the following areas:

- Development and demonstration of new or improved product and process technologies including those for specialised capital goods, for both domestic and export markets
- Absorption and upgradation of imported technology.

The partial financial support by DSIR in the above areas primarily covers prototype development and pilot plant work, test and evaluation of products flowing from such R&D, user trials etc.

NOTES

Bulk of the financial support to the projects is to be from industry's resources. The financial support for DSIR is mainly to meet part of the development expenditure of:

- Raw materials, components and other development expenditures for making prototypes or building up of pilot plants and experimentation thereon for optimisation of processes. Product/process simulation know-why studies.
- Consumables and other operational costs in experimental work.
- Testing and evaluation, field trials/user trials.
- Consultancy/research assistance from National Research Organisations and Institutions.

6.10 GLOBAL INNOVATION INDEX

The Global Innovation Index (GII) is recognition of the key role that innovation serves as a driver of economic growth and prosperity. It also an acknowledgement of the need for a broad horizontal vision of innovation that is applicable to both developed and emerging economies, with the inclusion of indicators that go beyond the traditional measures of innovation (such as the level of research and development in a given country). The GII is a valuable benchmarking tool to facilitate public-private dialogue, whereby policymakers, business leaders and other stakeholders can evaluate progress on a continual basis.

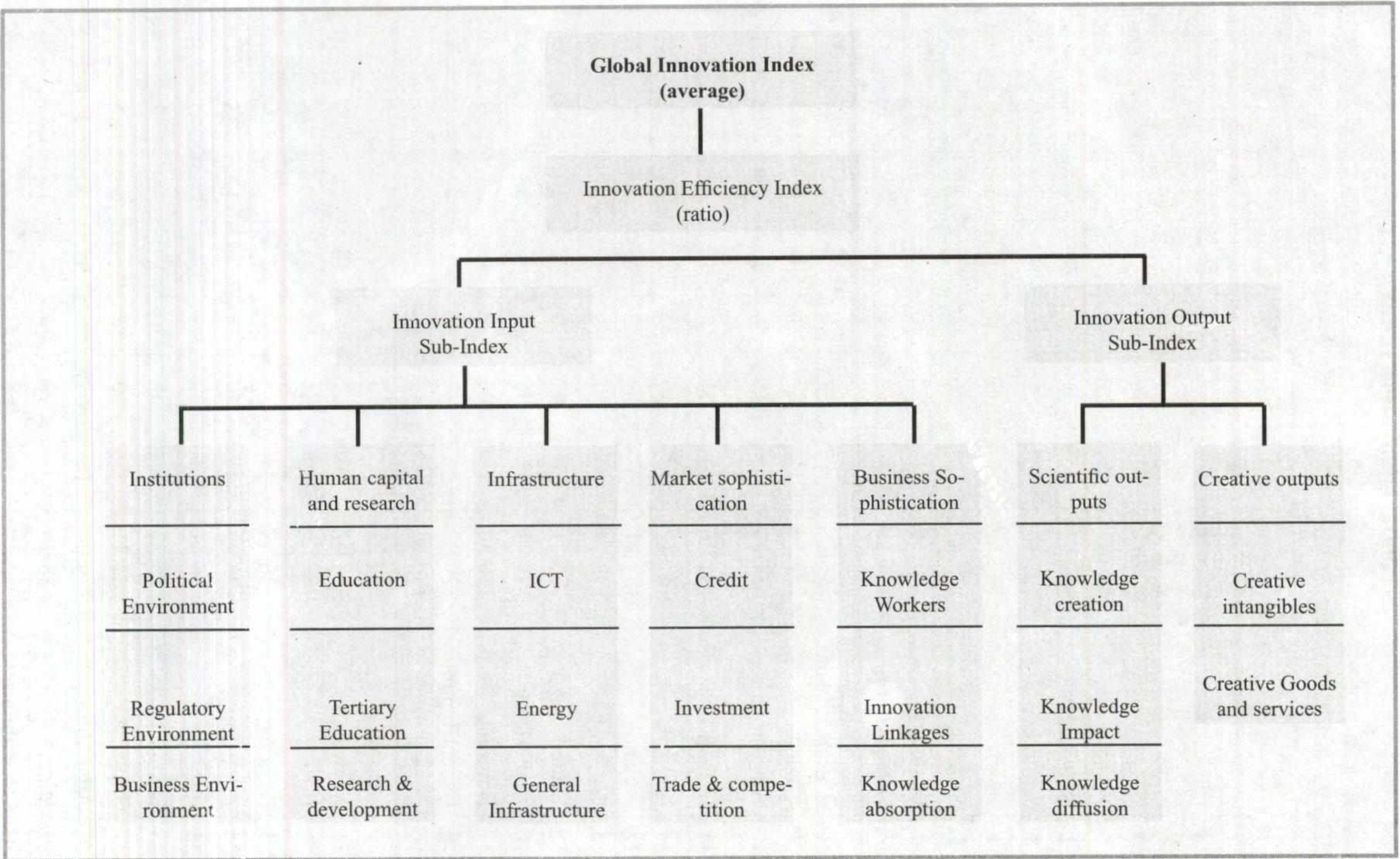
The Global Innovation Index Framework

The Global Innovation Index 2011 (GII) relies on two sub-indices, the Innovation Input Sub-Index and the Innovation Output Sub-Index, each built around pillars.

Five input pillars capture elements of the national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. Two output pillars capture actual evidence of innovation outputs: (6) Scientific outputs and (7) Creative outputs.

Each pillar is divided into sub-pillars and each sub-pillar is composed of individual indicators. Sub-pillar scores are calculated as the weighted average of individual indicators; pillar scores are calculated as the simple average of the sub-pillar scores. Four measures are then calculated:

- The Innovation Input Sub-Index is the simple average of the first five pillar scores.
- The Innovation Output Sub-Index is the simple average of the last two pillar scores.
- The overall GII is the simple average of the Input and Output Sub-Indices.
- The Innovation Efficiency Index is the ratio of the Output Sub- Index over the Input Sub-Index


Global Innovation Index
(average)
Innovation Efficiency Index
(ratio)
Innovation Input
Sub-Index
Innovation Output
Sub-Index
Institutions
Human capital
and research
Infrastructure
Market sophisti-
cation
Business So-
phistication
Scientific out-
puts
Creative outputs
Political
Environment
Education
ICT
Credit
Knowledge
Workers
Knowledge
creation
Creative
intangibles
Regulatory
Environment
Tertiary
Education
Energy
Investment
Innovation
Linkages
Knowledge
Impact
Creative Goods
and services
Business Envi-
ronment
Research &
development
General
Infrastructure
Trade & compe-
tition
Knowledge
absorption
Knowledge
diffusion

NOTES

Global Innovation Index

		Factor Rank							
Rank	Country	Bloomberg Innovation Quotient	R&D Intensity	Manufacturing Capability	Productivity	Hi-Tech Density	Teriary Efficiency	Researcher Concentration	Patent Activity
1	Finland	140	3	10	15	7	2	1	21
2	Singapore	139.24	12	4	6	9	N/A	5	45
3	South korea	137.54	7	5	30	5	1	20	5
4	Japan	137.49	4	17	25	11	19	3	6
5	Sweden	135.41	2	20	14	2	11	4	18
6	Germany	135.16	9	12	16	3	50	15	12
7	United States	134.18	6	39	3	1	25	6	13
8	Switzerland	132.14	5	15	20	14	28	12	31
9	France	131.54	11	57	8	8	9	17	14
10	Austria	131.44	13	18	9	13	39	18	23
11	Ireland	131.25	23	11	4	17	6	22	36
12	Slovenia	131.15	21	14	28	N/A	34	23	16
13	Iceland	131.01	8	59	22	N/A	18	2	76
14	Denmark	130.13	10	37	18	18	15	7	42
15	United kingdom	129.71	18	42	10	22	10	14	26
16	Netherlands	129.31	17	38	13	6	33	21	39
17	Belgium	129.30	14	36	5	16	24	19	46
18	Czech Republic	129.08	22	9	34	N/A	42	30	32
19	Canada	128.90	15	58	12	21	12	11	41
20	Belarus	127.25	37	13	52	N/A	7	N/A	4
21	Norway	127.02	20	62	2	15	21	8	40
22	Russia	126.68	26	45	47	33	3	16	1
23	Ukraine	126.58	28	23	63	N/A	5	N/A	2
24	Lithuania	125.79	41	29	39	N/A	13	25	22
25	Italy	125.61	27	24	17	20	26	37	8
26	Hungary	125.34	31	8	36	19	38	33	34
27	Slovakia	125.21	47	16	32	N/A	29	28	37
28	Australia	124.08	16	67	7	24	4	9	19
29	Israel	123.29	1	78	23	4	16	N/A	50
30	Luxembourg	122.95	19	68	1	30	71	10	38

31	Estonia	122.83	36	41	38	N/A	37	24	69
32	China	122.42	25	3	70	12	68	42	15
33	Spain	121.25	30	50	21	49	14	26	28
34	Poland	120.93	46	31	37	27	17	32	11
35	Croatia	120.25	34	27	33	42	57	35	48
36	Malaysia	119.76	44	2	44	23	41	52	53
37	Portugal	119.59	32	46	35	40	23	27	60
38	New zealand	119.28	24	66	29	39	8	13	30
39	South Africa Malta	118.98	33	35	50	29	N/A	51	3
40	Malta	118.76	50	25	31	N/A	64	40	52
41	Chile	118.29	42	44	45	N/A	45	44	62
42	Hong Kong	118.26	40	77	11	10	30	29	59
43	Argentina	118.10	52	19	43	N/A	52	40	49
44	Bulgaria	117.6	49	43	51	N/A	46	36	24
45	Thailand	116.30	61	1	65	26	35	N/A	54
46	Mexico	116.14	53	21	40	N/A	61	50	64
47	Romania	116.10	54	26	53	48	32	39	7
48	Latvia	115.96	51	65	46	34	27	34	20
49	Macedonia, FYR	115.45	57	40	42	N/A	62	45	33
50	Iran, Islamic Republic	115.35	38	72	48	N/A	54	N/A	25

Source: *Bloomberg, World Bank, Intellectual Property Organization, The Conference Board, OECD, UNESCO AS OF : April 20, 2012*

6.11 INNOVATION EFFICIENCY INDEX: INPUT INDEX AND OUTPUT INDEX

When the Input and Output Sub-Indices are plotted against each other, the data seem to confirm that efforts made on enabling environments are rewarded with increased innovation outputs. The Innovation Efficiency Index, calculated as the ratio of the Output over the Input Sub-Indices further explored this relationship.

The top 10 countries in the Innovation Efficiency Index are Côte d'Ivoire, Nigeria, China, Pakistan, Moldova, Sweden, Brazil, Argentina, India, and Bangladesh. This list includes some of the most densely inhabited countries in the world: China, India, Brazil, Bangladesh, and Nigeria are all among the 10 most populous countries in this year's sample, and place 1st on Efficiency in their regions (except for Bangladesh, which comes after India in South Asia). Three BRIC countries (Brazil, India, and China) are in this select list, with the fourth, the Russian Federation, coming in only

NOTES

at 52nd place. By region, the best performers are Côte d'Ivoire (1st), China (3rd), Pakistan (4th), Moldova (5th), Brazil (7th), Jordan (16th), and the US (26th). By income group, in descending order of income, leaders are Sweden (6th), Brazil (7th), Côte d'Ivoire (1st), and Bangladesh (10th).

Rank	Country	Score
1	Cote d'Ivoire	1.06
2	Nigeria	1.03
3	China	1.02
4	Moldova (Republic of)	1.01
4	Pakistan	1.01
6	Sweden	0.92
7	Brazil	0.91
8	Argentina	0.9
9	Bangladesh	0.89
9	Hungary	0.89
9	India	0.89
12	Switzerland	0.88
13	Germany	0.86
13	Jordan	0.86
13	Netherlands	0.86
13	Serbia	0.86
13	Venezuela (Bolivarian Republic of)	0.86
18	Qatar	0.85
19	Iran (Islamic Republic of)	0.84
20	Israel	0.83
20	Sri Lanka	0.83
20	Viet Nam	0.83
23	Lebanon	0.82
24	Korea (Republic of)	0.81
24	Paraguay	0.81
26	Costa Rica	0.8
26	Guyana	0.8
26	Turkey	0.8
26	United States of America	0.8
30	Cameroon	0.79
30	Estonia	0.79
30	Senegal	0.79
33	Armenia	0.78
33	Czech Republic	0.78
33	Finland	0.78
36	Cyprus	0.77
36	Ecuador	0.77

36	France	0.77
36	Guatemala	0.77
36	Mali	0.77
36	Tajikistan	0.77
36	Tanzania (United Republic of)	0.77
36	Tunisia	0.77
36	Uganda	0.77
36	Ukraine	0.77
46	Denmark	0.76
46	Iceland	0.76
46	New Zealand	0.76
46	Romania	0.76
46	Russian Federation	0.76
46	Slovenia	0.76
46	United Kingdom	0.76
46	Zimbabwe	0.76
54	Canada	0.75
55	Bulgaria	0.74
55	Thailand	0.74
57	Kuwait	0.73
58	Norway	0.72
58	Uruguay	0.72
60	Austria	0.71
60	Kyrgyzstan	0.71
62	Italy	0.7
62	Japan	0.7
62	Philippines	0.7
65	Croatia	0.69
65	Hong Kong (SAR), China	0.69
65	Portugal	0.69
68	Belgium	0.68
68	Benin	0.68
68	Bolivia	0.68
68	El Salvador	0.68
68	Honduras	0.68
68	Latvia	0.68
74	Colombia	0.67
74	Egypt	0.67
74	Spain	0.67
77	Macedonia (FYR)	0.66
77	Malaysia	0.66
77	Nicaragua	0.66
80	Georgia	0.65
80	Indonesia	0.65
80	Ireland	0.65

80	Luxembourg	0.65
80	Syrian Arab Republic	0.65
85	Poland	0.64
86	Cambodia	0.63
86	Ghana	0.63
86	Madagascar	0.63
86	Mauritius	0.63
90	Chile	0.62
90	Lithuania	0.62
90	Mexico	0.62
90	Slovakia	0.62
94	Greece	0.61
94	Singapore	0.61
96	Albania	0.59
96	Australia	0.59
96	Saudi Arabia	0.59
99	Brunei Darussalam	0.58
99	Burkina Faso	0.58
99	Malawi	0.58
99	Mongolia	0.58
103	Azerbaijan	0.57
103	Morocco	0.57
103	Trinidad and Tobago	0.57
106	Ethiopia	0.56
106	Sudan	0.56
108	Peru	0.55
109	Oman	0.54
109	United Arab Emirates	0.54
111	Yemen	0.53
112	Kazakhstan	0.52
112	South Africa	0.52
114	Botswana	0.51
114	Panama	0.51
116	Jamaica	0.49
116	Kenya	0.49
116	Rwanda	0.49
116	Swaziland	0.49
116	Zambia	0.49
121	Bosnia and Herzegovina	0.47
122	Bahrain	0.43
122	Namibia	0.43
124	Niger	0.36
125	Algeria	0.23

Source: *http://www.globalinnovationindex.org/gii/main/analysis/rankings.cfm#CGI.SCRIPT_NAME#*

6.11.1 Input Index

The Innovation Input Sub-Index variables provide information on indicators that measure elements that must be in place to foster innovation in an economy. The top 10 economies on the Innovation Input Sub-Index are Singapore, Hong Kong (SAR, China), Switzerland, Ireland, Sweden, Finland, Denmark, Canada, Luxembourg, and the UK. Regional leaders are Singapore (1st), Switzerland (3rd), Canada (8th), Israel (20th), Chile (36th), South Africa (40th), and India (87th).

The result for Ireland is driven by its excellent marks in Institutions and Market and Business sophistication. Although Ireland presents a good environment and potential for innovation, it lags behind on the Output Sub-Index where it ranks 22nd. Finland comes next, placing 6th on Input, 6th on Output, 5th on the GII, and 35th on Efficiency. Finland is ranked among the top 10 on five pillars: Institutions, Human capital and research, Infrastructure, Business sophistication, and Scientific outputs; the country's relative weaknesses are on the Market sophistication and Creative outputs pillars.

Innovation Input Sub-I

Rank	Country	Score
1	Singapore	74.11
2	Hong Kong (SAR), China	69.77
3	Switzerland	66.07
4	Ireland	65.53
5	Sweden	64.85
6	Finland	64.71
7	Denmark	64.57
8	Canada	64.41
9	Luxembourg	63.93
10	United Kingdom	63.66
11	United States of America	62.84
12	Australia	62.81
13	Iceland	62.48
14	Norway	61.15
15	New Zealand	60.97
16	Netherlands	60.42
17	Korea (Republic of)	59.43
18	Japan	59.34
19	Austria	59.28
20	Israel	59.12
21	Germany	59.04
22	Belgium	58.44
23	France	55.61
24	Estonia	54.86
25	United Arab Emirates	54.38

NOTES

26	Czech Republic	53.11
27	Malaysia	52.94
28	Bahrain	52.73
29	Spain	52.43
30	Cyprus	52.38
31	Qatar	51.71
32	Slovenia	51.29
33	Hungary	51.04
34	Portugal	50.32
35	Slovakia	48.27
36	Chile	48.09
37	Italy	47.88
38	Latvia	47.46
39	Lithuania	47.46
40	South Africa	46.37
41	Poland	46.29
42	Oman	46.23
43	China	46.08
44	Saudi Arabia	45.94
45	Croatia	45
46	Mauritius	44.79
47	Bulgaria	44.2
48	Thailand	43.33
49	Namibia	43.01
50	Greece	42.48
51	Kuwait	42.44
52	Mongolia	42.31
53	Costa Rica	42.22
54	Bosnia and Herzegovina	42.1
55	Romania	41.8
56	Jordan	41.34
57	Lebanon	40.88
58	Trinidad and Tobago	40.86
59	Russian Federation	40.79
60	Panama	40.73
61	Macedonia (FYR)	40.37
62	Botswana	40.37
63	Viet Nam	40.09
64	Kazakhstan	39.86
65	Ghana	39.84
66	Uruguay	39.69

NOTES

67	Ukraine	39.59
68	Brazil	39.47
69	Kenya	39.24
70	Brunei Darussalam	39.19
71	Serbia	39.09
72	Peru	39.06
73	Jamaica	38.89
74	Colombia	38.72
75	Guyana	38.7
76	Georgia	38.54
77	Moldova (Republic of)	38.4
78	Albania	38.29
79	Tunisia	38.21
80	Turkey	37.96
81	Mexico	37.47
82	Argentina	37.29
83	Azerbaijan	37.21
84	Armenia	37.1
85	Swaziland	36.93
86	Morocco	36.65
87	India	36.47
88	Egypt	35.08
89	Kyrgyzstan	34.93
90	Rwanda	34.73
91	El Salvador	34.6
92	Paraguay	34.45
93	Philippines	34
94	Zambia	33.81
95	Indonesia	33.57
96	Sri Lanka	33.2
97	Guatemala	33.18
98	Honduras	33.08
99	Malawi	32.82
100	Ecuador	32.57
101	Algeria	32.07
102	Niger	31.44
103	Cambodia	31.24
104	Madagascar	31.2
105	Nicaragua	31.13
106	Iran (Islamic Republic of)	30.91

NOTES

107	Senegal	30.73
108	Tanzania (United Republic of)	30.45
109	Bolivia	30.37
110	Cameroon	30.12
111	Syrian Arab Republic	30.03
112	Uganda	29.86
113	Mali	29.85
114	Bangladesh	29.64
115	Venezuela (Bolivarian Republic of)	29.48
116	Ethiopia	29.29
117	Burkina Faso	29.24
118	Benin	28.26
119	Nigeria	27.72
120	Tajikistan	27.64
121	Yemen	27
122	Zimbabwe	26.82
123	Pakistan	26.57
124	Sudan	26.06
125	Cote d'Ivoire	23.4

Source: *http://www.globalinnovationindex.org/gii/main/analysis/rankings.cfm#CGI.SCRIPT_NAME#*

6.11.2 Innovation Output Sub-Index

The Innovation Output Sub-Index variables provide information on elements that are the result of innovation within an economy. The top 10 countries in the Innovation Output Sub-Index are Sweden, Switzerland, the Netherlands, Germany, the US, Finland, Denmark, Israel, the UK, and Canada. The best-ranked economies within each region are Sweden (1st), the US (5th), Israel (8th), the Republic of Korea (11th), Brazil (32nd), India (44th), and Nigeria (62nd).

The Netherlands comes in 3rd on the Output Sub-Index, a performance driven by marks within the top 10 in international Patent Cooperation Treaty applications by residents, scientific and technical journal articles, total computer software spending, royalty and license fees' receipts, daily newspapers' circulation, and creative services exports. This excellent result allows it to be ranked 9th in the overall GII, despite its 16th place on the Input side.

Innovation Output Sub-Index

Rank	Country	Score
1	Sweden	59.4
2	Switzerland	58.2

3	Netherlands	52.2
4	Germany	50.74
5	United States of America	50.3
6	Finland	50.29
7	Denmark	49.34
8	Israel	48.94
9	United Kingdom	48.27
10	Canada	48.26
11	Korea (Republic of)	47.93
12	Hong Kong (SAR), China	47.83
13	Iceland	47.72
14	China	46.77
15	New Zealand	46.61
16	Hungary	45.2
17	Singapore	45.18
18	Norway	44.04
19	Qatar	43.77
20	Estonia	43.5
21	France	42.9
22	Ireland	42.67
23	Austria	42.21
24	Czech Republic	41.49
25	Luxembourg	41.37
26	Japan	41.3
27	Cyprus	40.52
28	Belgium	39.66
29	Moldova (Republic of)	38.92
30	Slovenia	38.86
31	Australia	36.89
32	Brazil	36.03
33	Jordan	35.52
34	Spain	35.19
35	Malaysia	35.17
36	Portugal	34.47
37	Costa Rica	33.6
38	Serbia	33.53
39	Italy	33.49
40	Argentina	33.44

NOTES

41	Lebanon	33.34
42	Viet Nam	33.34
43	Bulgaria	32.64
44	India	32.56
45	Latvia	32.14
46	Thailand	31.93
47	Romania	31.86
48	Croatia	30.96
49	Guyana	30.95
50	Russian Federation	30.91
51	Kuwait	30.85
52	Ukraine	30.42
53	Turkey	30.25
54	Slovakia	29.83
55	Poland	29.74
56	United Arab Emirates	29.61
57	Chile	29.6
58	Tunisia	29.57
59	Lithuania	29.52
60	Armenia	28.9
61	Uruguay	28.67
62	Nigeria	28.58
63	Mauritius	28.15
64	Paraguay	27.9
65	Sri Lanka	27.53
66	Saudi Arabia	26.94
67	Pakistan	26.94
68	Macedonia (FYR)	26.57
69	Bangladesh	26.47
70	Colombia	25.92
71	Iran (Islamic Republic of)	25.91
72	Greece	25.89
73	Guatemala	25.49
74	Venezuela (Bolivarian Republic of)	25.35
75	Georgia	25.2
76	Ghana	25.12
77	Ecuador	24.94
78	Oman	24.79

Check Your Progress
Fill in the Blanks:

4. .... is essentially a knowledge based profession.
5. The Important role of the .... is to stimulate the innovation thinking of the Research & Development Personnel.
6. .... is a recognition key role that innovation serves as a driver of economic growth and prosperity.

79	Cote d'Ivoire	24.77
80	Kyrgyzstan	24.65
81	Mongolia	24.49
82	Senegal	24.38
83	South Africa	24.07
84	Philippines	23.96
85	Cameroon	23.79
86	El Salvador	23.67
87	Trinidad and Tobago	23.47
88	Mexico	23.42
89	Egypt	23.34
90	Tanzania (United Republic of)	23.3
91	Uganda	22.87
92	Bahrain	22.87
93	Mali	22.85
94	Brunei Darussalam	22.68
95	Albania	22.62
96	Honduras	22.53
97	Indonesia	21.99
98	Peru	21.63
99	Tajikistan	21.36
100	Azerbaijan	21.13
101	Panama	20.82
102	Morocco	20.81
103	Kazakhstan	20.77
104	Botswana	20.65
105	Bolivia	20.51
106	Nicaragua	20.44
107	Zimbabwe	20.26
108	Cambodia	19.68
109	Madagascar	19.63
110	Syrian Arab Republic	19.61
111	Bosnia and Herzegovina	19.58
112	Benin	19.35
113	Malawi	19.11
114	Kenya	19.05
115	Jamaica	18.87
116	Namibia	18.46

117	Swaziland	18.11
118	Burkina Faso	17.04
119	Rwanda	17
120	Zambia	16.73
121	Ethiopia	16.47
122	Sudan	14.65
123	Yemen	14.44
124	Niger	11.38
125	Algeria	7.52

6.12 SUMMARY

- Management of technology and innovation is a relatively new concept. It has begun to find applications in India and is expected to rapidly occupy a dominant role.
- The objective of corporate function of R&D is to provide strategic managerial inputs to strengthen the process of technology development, innovation and entrepreneurship in an organisation.
- There is a scheme under which well operated in-house R&D units of industry are granted recognition by the Government (i.e. DSIR).
- The essence of the relationship in technology development between two or more partners is that there is a give and take attitude with the common objective of a win-win situation for all the partners involved in the task.
- International experience indicates that venture Capitals make 4-10 times of the money that they have invested from the successful ventures. This covers not only the losses that they may incur from the ventures that fail but also leave a significant profit for themselves.
- Consultancy is essentially a knowledge-based profession and consultants are often termed as carriers of technology and related services.
- An important role of the manager of R&D is to stimulate the innovative thinking of the R&D personnel. The manager can stimulate people to take new looks at old technologies, find new application for them and make suitable innovations.
- These central agencies, along with efforts of States/ Union Territories, have been undertaking many policy initiatives and measures as well as announcing many schemes and programmes with a view to promote innovation and S&T in the country.
- The Global Innovation Index (GII) is recognition of the key role that innovation serves as a driver of economic growth and prosperity.
- The Innovation Efficiency Index, calculated as the ratio of the Output over the Input Sub-Indices further explored this relationship.

6.13 KEY TERMS

- **Consultancy:** Consultancy is essentially a knowledge-based profession and consultants are often termed as carriers of technology and related services.
- **Global Innovation Index (GII):** Global Innovation Index (GII) is recognition of the key role that innovation serves as a driver of economic growth and prosperity.
- **Innovation Input Sub-Index:** Innovation Input Sub-Index is the simple average of the first five pillar scores.
- **Innovation Output Sub- Index:** Innovation Output Sub-Index is the simple average of the last two pillar scores.
- **Innovation Efficiency Index:** Innovation Efficiency Index is the ratio of the Output Sub- Index over the Input Sub-index

6.14 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Strategic Planning
2. partnership
3. IDBI
4. Consultancy
5. Research and Development Manager
6. The Global Innovation Index

6.15 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Define R&D as a corporate function.
2. Write a note on partnership in innovation.
3. What are the key financers of R&D projects?

Long-Answer Questions

1. Discuss the role of consultants in R&D.
2. How to create a productive team culture?
3. Discuss the government support for R&D and researchers.
4. What is the role of DST, DBT and CSIR in R&D?
5. Write a note on global innovation index.

MODEL QUESTION PAPER

DISTANCE EDUCATION

MBA Degree Examination

Fourth Semester

Management of Innovation and R&D

Time: Three hours *Maximum: 100 Marks*

PART A **(5 × 8 = 40 Marks)**

Answer any FIVE Questions

1. Define Innovation and Illustrate the Jay Doblin's 10 types of innovation.
2. Summarise atleast ten qualities that describe innovators.
3. Write a short note on the following:
   (i) Jennifer Goddard's six focus areas of the innovation.
   (ii) 4 P's of innovation.
4. Summarise the strength and challenges for promoting R&D and technological innovation.
5. Write a short note on the following:
   (i) Heuristics.
   (ii) Brainstorming.
   (iii) Synectics.
6. Illustrate the phases of creative process through diagram and explain all the four stages to the creative process.
7. Write a short note on the following:
   (i) Creativity Profile.
   (ii) Sources of Innovation.
   (iii) List Peter Drucker's seven innovation.
8. Illustrate the 4 Zone's of innovation through diagram and explain in detail.

PART B **(4 × 15 = 60 Marks)**

Answer any FOUR questions

9. Read the following case study thoroughly and answer the questions carefully.

   Southwest Airlines is in a very competitive industry. Most of the major players are in bankruptcy or have recently emerged from bankruptcy. Southwest has never failed to produce a profit for its investors, and it is consistently ranked in

the top 100 "Best Places to Work." It does not offer Product Performance that is significantly different from any other airline. It completes by being innovative in the following areas:

NOTES

- Business Model: Low cost, low frills. Southwest can turn a profit on lower margins than its competitors. It works with the same unions as the other airlines and offers competitive salaries. It reduces cost in other areas of its operations.
- Network and Affiliations: Southwest has adopted servant leadership and studies and learns from other great Dallas based servant led organizations. Southwest has developed affiliation with professional sports franchises to offer special packages for sporting events.
- Enabling Process: Southwest has many innovative processes to support their employees. Their Corporate Culture committees and caring-Servant Leadership provide engaging work for over 30,000 employees.
- Core Process: Southwest does not have the added cost of major hubs, Southwest is able to turn around their planes at a gate faster than most other airlines. This allows their planes to spend more time in the air and less time sitting on the ground.
- Service: Southwest is legendary for going the extra mile for its customers, even with a low cost, no frills business model. Employees are empowered to make decisions and to spend money as long as it makes a customer happy. Employees trust that they can make a decision and they will be supported. Southwest makes low cost travelers feel special and appreciated.
- Channel: Southwest reaches its customers through the internet and through simple quirky advertisements.
- Brand: Southwest sells "LOVE" and "Freedom" not just airline tickets. When you fly with Southwest you are part of a family, engaged in battle with the giant companies that would try to take away your freedom to fly.
- Customer Experience: Southwest passengers enjoy humorous and entertaining flight attendants and flight crews. Customers feel the "LOVE" that Southwest markets.

Questions:

(i) South west Airlines has never failed to produce a profit for its investors. What are all the steps adopted by the South west Airlines to meet these success.

(ii) What are the Channel and Brand adopted by South west Airlines for making its success?

(iii) How the service and customer experience handled by South west Airlines.

NOTES

10. Write a note on behavioral theory of R & D investment and innovation. Also state the differences between the open and closed innovation approach.
11. Define Breakthrough innovation and define benchmarking. Discuss the phases of benchmarking in detail.
12. (a) What are the key innovative features of the following firms?
    (i) Face book
    (ii) Apple
    (iii) Google
    (iv) IPL (20-20).

    (b) Discuss the importance of organisation support for encouraging organisation innovation.
13. (a) Define Reverse Engineering (RE) and summarise the reasons that RE exists till date and the usage is increasing in each year?

    (b) Discuss the laws regarding the protection of innovation.
14. (a) What are the objectives of corporate function of Research Development.

    (b) Summarise the Board of Directors of a company directions of the Research and Development department.
15. (a) Discuss the government support for R & D and researchers.

    (b) Write a short note on the following:
    (i) R & D as a corporate function.
    (ii) Partnership in innovation.
    (iii) The role of DST, DBT, and CSIR in R & D.

MBA (PRODUCTION AND OPERATIONS MANAGEMENT)

PAPER - 4.2

MANAGEMENT OF INNOVATION AND R&D



ALAGAPPA UNIVERSITY

(A State University Established by the Government of Tamilnadu-
Reaccredited with 'A' Grade by NAAC)
KARAIKUDI – 630 003
Tamil Nadu, INDIA

DIRECTORATE OF DISTANCE EDUCATION

(Recognized by Distance Education Council (DEC), New Delhi)

